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Sewage Treatment Facilities for the South Bloomington and Lake Monroe Service Areas, Bloomington, Indiana

Environmental Protection Agency, Chicago, Ill

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U.S. ENVIRONMENTAL
PROTECTION AGENCY
REGION V

ENVIRONMENTAL IMPACT STATEMENT

DRAFT

Sewage Treatment Facilities for the South Bloomington and Lake Monroe Service Areas Bloomington, Indiana

March 1976

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The analysis of alternatives indicates that the needs of the South Bloomington Service Area would most adequately be served by a 15 MGD two-stage activated sludge sewage treatment plant (STP) with sand filters located at the Dillman Road site. (The present flow diversion of 2 MGD to the north STP will continue.) Sludge treatment recommended is aerobic digestion, concentration by centrifugation followed by composting, agronomic land spreading and/or landfilling of the processed sludge. Discharge of the treated effluent will be to Clear Creek.

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DRAFT ENVIRONMENTAL IMPACT STATEMENT
For
SEWAGE TREATMENT FACILITIES
FOR THE SOUTH BLOOMINGTON AND LAKE MONROE SERVICE AREAS,
BLOOMINGTON, INDIANA

Prepared By The
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
Chicago, Illinois

With The Assistance of
GILBERT ASSOCIATES, INC.
READING, PENNSYLVANIA

APPROVED BY:
Francis T. Mayo
FRANCIS T. MAYO
REGIONAL ADMINISTRATOR
MARCH 1976

SUMMARY SHEET

(X) Draft

( ) Final

U.S. Environmental Protection Agency Region V, Chicago

1. (X) Administrative Action

   ( ) Legislative Action

2. Description of the Action

The analysis of alternatives indicates that the needs of the South Bloomington Service Area would most adequately be served by a 15 MGD two-stage activated sludge sewage treatment plant (STP) with sand filters located at the Dillman Road site. (The present flow diversion of 2 MGD to the north STP will continue.) Sludge treatment recommended is aerobic digestion, concentration by centrifugation followed by composting, agronomic land spreading and/or landfilling of the processed sludge. Discharge of the treated effluent will be to Clear Creek.

Constructing a new sewage treatment plant at the Dillman Road site will result in abandonment of the existing Winston Thomas STP and will require the construction of a connecting sewer approximately 2 miles long paralleling Clear Creek from the Winston Thomas plant site to the Dillman Road site. The South Bloomington Service Area is located in Monroe County, Indiana.

3. Environmental Impact

Water

The present waste load allocation on Clear Creek will be met by the proposed project. This will result in a significant improvement in the existing water quality in Clear Creek.

Increased siltation and temporary flow interruption may occur during construction of the connecting sewer along Clear Creek and also from relocation and channelization of Clear Creek at the Dillman Road site.

Air Quality

Dust generated from construction activities may temporarily change ambient conditions. No significant change in air quality is anticipated from implementation of this project.

Land Use

Implementation of the project provides the opportunity for growth to occur in the South Bloomington Service Area while retaining centralization of sewer service consistent with the geographic drainage area and the 20 year population projections.

Biology

Terrestrial plants and animals will be displaced by construction activities. Revegetation after construction will provide some biological recovery.

4. Alternatives Considered

a) Regionalization of the South Bloomington Service Area and the Lake Monroe Regional Waste District.

b) Continuing diversion of approximately 2 MGD to the North Bloomington Service Area STP for treatment.

c) Site Locations

  1) 4 sites on Clear Creek

  2) 1 site on Salt Creek

d) Treatment Processes

  1) Activated Sludge

  2) Pure Oxygen

e) Sludge Processing and Disposal - 9 alternative combinations examined.

f) Discharge points

  1) Clear Creek

  2) Salt Creek

g) No Action.

5. Irreversible and Irretrievable Commitment of Resources

Capital, labor and energy expended in construction of the proposed facilities. Land use of the Dillman Road site (including relocation of Clear Creek) for a sewage treatment plant over the useful life of the proposed facilities and associated operation and maintenance costs.

6. Federal, State and Local Agencies Notified of this Action

Federal

- Senator Birch Bayh
- Senator Vance Hartke
- Representative Lee Hamilton
- Representative John Myers
- Council on Environmental Quality
- Environmental Protection Agency
- Army Corps of Engineers, Louisville, Kentucky
- Department of the Interior
- Geological Survey
- Fish & Wildlife Service
- Dept. of Health, Education and Welfare
- Farmers Home Administration, Indianapolis, Indiana
- Forest Service
- National Park Service

State

- Honorable Otis R. Bowen, M.D.
- Indiana Stream Pollution Control Board
- Indiana Highway Planning Commission
- Indiana Legislative Council
- Department of Natural Resources
- Planning, Service Agency, Department of Commerce
- Indiana Geological Survey

Local

- Francis McCloskey, Mayor, City of Bloomington
- Monroe County Planning Commission
- City Environmental Control Commission
- City of Bloomington Utilities
- School of Public and Environmental Affairs, Indiana University
- Chamber of Commerce
- Environmental Quality and Conservation Commission
- Lake Monroe Regional Waste District

6. Dates

Draft statement made available to :

The Council on Environmental Quality	March 1976
The Public	March 1976

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Portions of this Environmental Impact study were taken directly from Gilbert Associates final report to USEPA. "Investigations of Key Issues ... for Sewage Treatment

Facilities for the South Bloomington and Lake Monroe Service Area, "(December 1975), the Facilities Plan (December 1974) and First Amendment (December 1975) for the Bloomington, Indiana - Lake Monroe Area prepared by Black & Veatch, Kansas City, Missouri and the "Lake Monroe Regional Waste District's Facilities Plan" (October 1974) prepared by Beam, Longest & Neff, Inc., Indianapolis, Indiana.

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CHAPTER 1
BACKGROUND

A. Identification of Grant Applicants and Consultants

The grant applicants for the proposed wastewater treatment facilities are the City of Bloomington Utilities (CBU), and the Lake Monroe Regional Waste District (LMRWD) in Indiana. The facilities plan for the City of Bloomington was prepared by Black & Veatch, Kansas City, Missouri. The facilities plan for the LMRWD was prepared by Beam, Longest & Neff, Inc. of Indianapolis, Indiana.

These facilities plans were submitted to USEPA as one document with the City of Bloomington as the lead agency since regionalization of the two wastewater treatment service areas is one of the major considerations in developing a facilities plan for the planning areas. The consulting firm of Gilbert Associates, Inc., Reading, Pennsylvania was hired by USEPA to provide additional analyses of alternatives and impacts associated with implementation of various plans.

B. Description of the Applicants' Proposed Action. *

Construction of a 20 MGD single stage complete mix activated sludge STP with sand filtration of the effluent, aerobic digestion of sludge followed by lagooning and soil injection on the Salt Creek site. This STP would be a regional facility providing service to the South Bloomington Service Area (20 yr. flow projection of 17 MGD) and the Lake Monroe Regional Waste District (20 yr. flow projection of 3 MGD). To transport the existing flows from the Winston Thomas STP to the Salt Creek site a 13.4 mile, 50 MGD gravity sewer along Salt Creek would be constructed.

C. General and Specific Location of the Proposed Action.

Bloomington, Indiana is located approximately 50 miles SSW of Indianapolis, Indiana (see Figure 1-1). Figure 1-2 displays surface drainage in the Bloomington area. The planning areas under consideration for sewage treatment facilities are the South Bloomington Service Area, and the Lake Monroe Regional Waste District (see Figure 1-3). The South Bloomington Service Area is presently served by both the Winston Thomas and Blucher Poole STP. (Approximately 2 MGD is pumped via force main from the South Service Area for treatment at Blucher Poole STP). The LMRWD Service Area has package treatment plants located primarily around Lake Monroe. The communities of Smithville, Sanders, and Harrodsburg in the LMRWD do not have sewerage service and rely on septic systems for sewage treatment.

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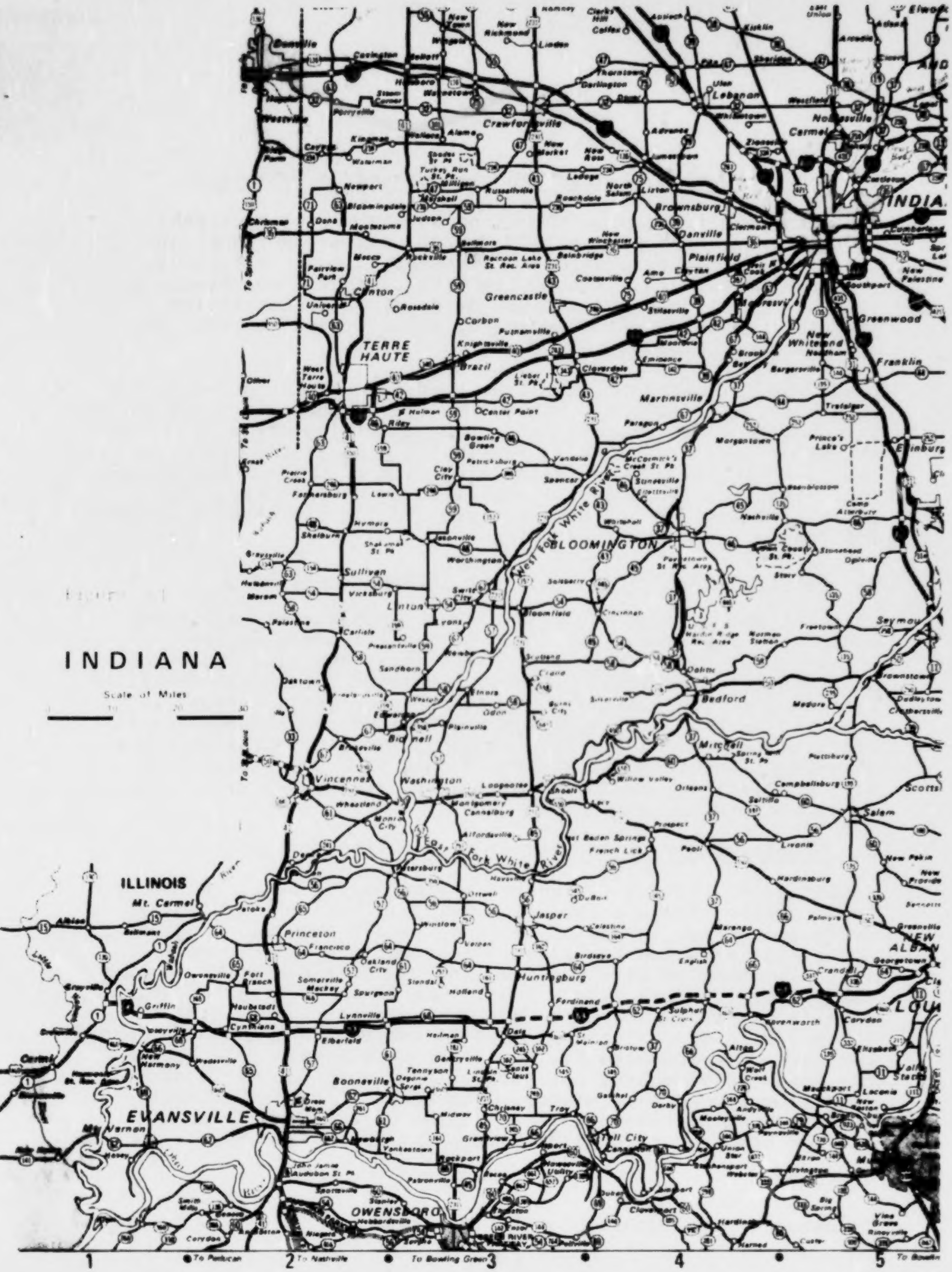
* Based on applicants' facilities Plans


INDIANA
Scale of Miles
0
10
20
30
ILLINOIS
Mt. Carmel
Albion
Grayville
Carmi
Mt. Vernon
EVANSVILLE
Princeton
Vincennes
Washington
TERRE HAUTE
Brazil
Greencastle
Crawfordsville
Danville
Covington
Newport
Clinton
Rockville
Sullivan
Linton
Bloomfield
BLOOMINGTON
Martinsville
Spencer
Mooresville
Plainfield
Brownsburg
Lebanon
Noblesville
Carmel
INDIANAPOLIS
Greenwood
Franklin
Nashville
Seymour
Bedford
Mitchell
Paoli
Salem
Jasper
Huntingburg
Boonville
Tell City
Corydon
NEW ALBANY
OWENSBORO
West Fork White River
East Fork White River
Ohio River
1
2
3
4
5
To Paducah
To Nashville
To Bowling Green
To Bowling Green

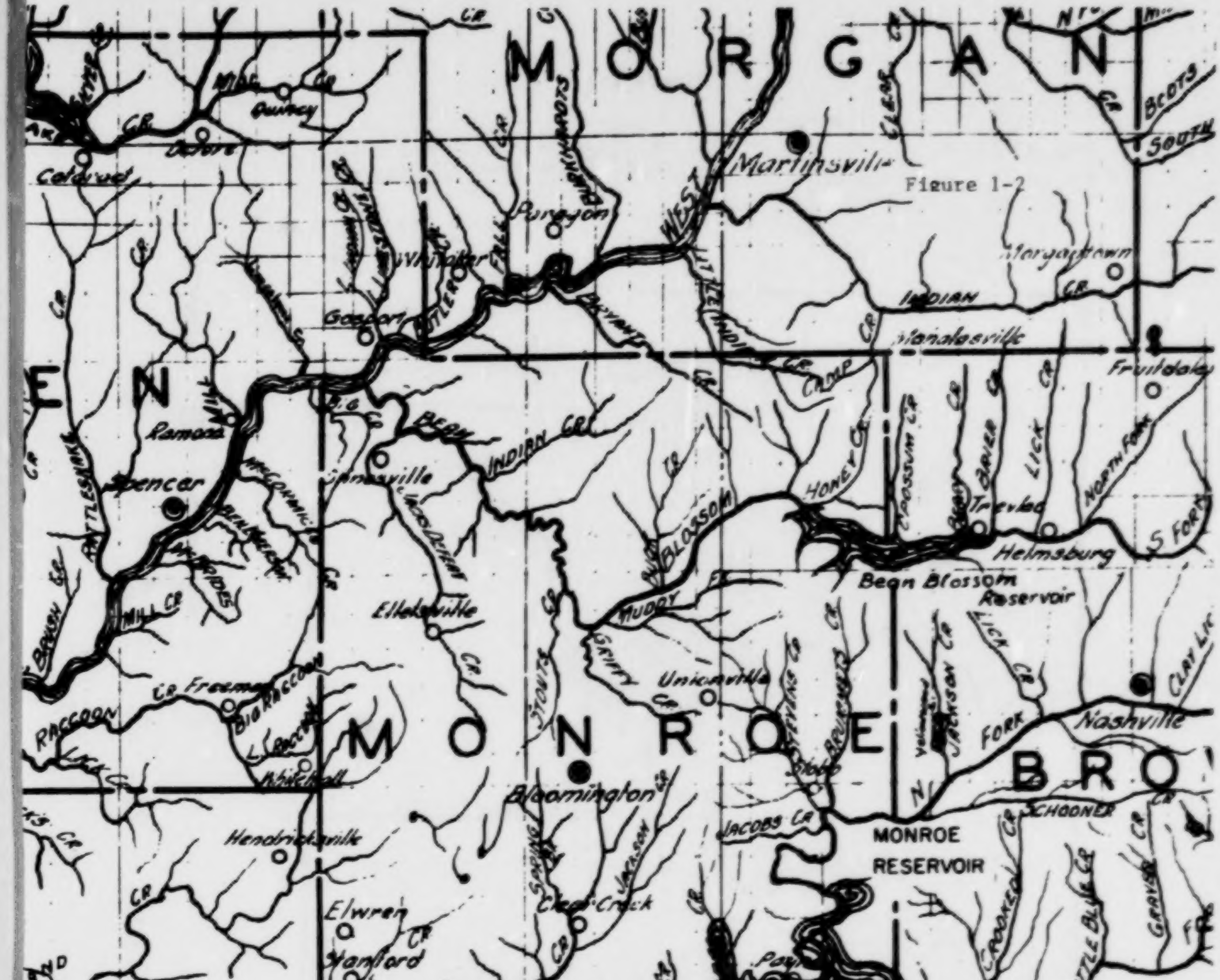
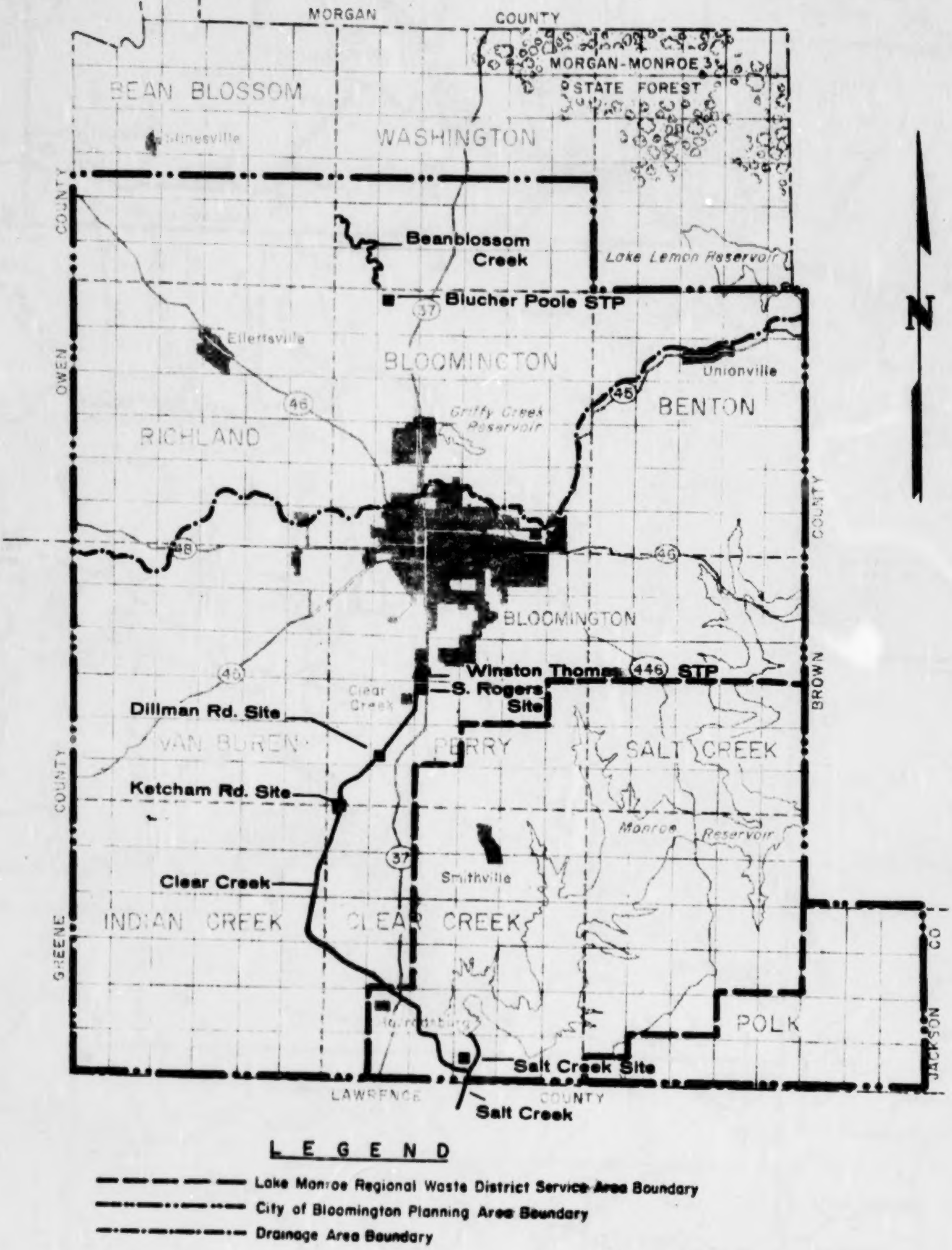


Figure 1-2

MORGAN
Martinsville
Paragon
Morgantown
Mahalasville
Whitaker
Gosport
Quincy
Cataract
Spencer
Ramona
Freedom
Stinesville
Ellettsville
Unionville
Fruitdale
Trevlac
Helmsburg
Bean Blossom Reservoir
Nashville
MONROE
Bloomington
MONROE RESERVOIR
BRO
Whitehall
Hendricksville
Elwren
Stanford
Clear Creek
Smithville
Spoor
Solsberry
Elkinsville
Cincinnati
Buena Vista
Harrodsburg
Popcorn
Guthrie
Bartlettsville
Heltonville
Norman
Zelma
Koleen
Dresden
Owensburg
Springville
Avoca
Peerless
Oolitic
Bedford
Erie
Bloomfield Springs
STATE FISH HATCHERY
WEST
INDIAN CR.
BEAN BLOSSOM
MUDDY
SALT CR.
LITTLE BLUE CR.
MIDDLE
NORTH FORK
S FORK
BEECH CR.
RACCOON
BIG RACCOON
INDIAN CR.
CLEAR CR.
STOUTS CR.
GRIFFY
JACKSON
JACOBS CR.
SCHOONER
CROOKED CR.
GRAVES
LEATHERWOOD
SOUTH FORK
PLEASANT RUN
KNOB
LITTLE SALT
BRATHERS CR.

Figure 1-3


MORGAN
COUNTY
MORGAN-MONROE
STATE FOREST
BEAN BLOSSOM
Stinesville
WASHINGTON
Beanblossom
Creek
Lake Lemon Reservoir
Blucher Poole STP
37
N
Ellettsville
BLOOMINGTON
Unionville
46
46
BENTON
Griffy Creek
Reservoir
RICHLAND
OWEN
COUNTY
48
46
BLOOMINGTON
Winston Thomas
446
STP
46
Clear
Creek
S. Rogers
Site
Dillman Rd. Site
VAN BUREN
PERRY
SALT CREEK
Ketcham Rd. Site
COUNTY
BROWN
COUNTY
Monroe Reservoir
37
Smithville
Clear Creek
INDIAN CREEK
CLEAR CREEK
GREENE
Harrodsburg
POLK
CO
JACKSON
Salt Creek Site
LAWRENCE
COUNTY
Salt Creek
LEGEND
Lake Monroe Regional Waste District Service Area Boundary
City of Bloomington Planning Area Boundary
Drainage Area Boundary

PLANNING AREA MAP

Effluent discharges in the south drainage basin of the planning area are to Clear Creek (from the Winston Thomas STP and Caslon Package Plant) which flows generally south to its confluence with Salt Creek. (Lake Monroe discharges to Salt Creek with a minimum controlled release of 32 MGD.) Salt Creek flows into the East Fork of the White River which becomes confluent with the West Fork of the White River near Petersburg, Indiana. The White River flows west into the Wabash and the Wabash flows generally south discharging to the Ohio River. In the north drainage basin, the Blucher Poole STP discharges its effluent to Bean Blossom Creek which flows into the West Fork of the White River.

D. Water Quality and Water Quantity Problems in the Area

1. Sources of Water Supply in the Service Area.

The major sources of water in the Bloomington area are the Lake Lemon, Griffy Creek, and Lake Monroe Reservoirs with Lake Monroe being the primary water supply for the City of Bloomington and the LMRWD. Groundwater does not supply a significant quantity of water in the planning area due to the proximity of the limestone bedrock near the surface throughout much of the area. As in other limestone regions, water from ground supplies or issuing from springs is not filtered as well as water taken from sand or gravel aquifers. Pollution of the groundwater supply by infiltration from septic tank drainage fields and polluted suface water can be a serious problem. Unfavorable geological conditions require deep wells drilled through bedrock and generally such wells do not yield adequate quantities of good quality water for household use. For this reason, most rural development is served by rural water districts that purchase water from the Bloomington municipal water system which utilizes Lake Monroe water as its major source. At the present time there are no municipal water supplies in Monroe County using groundwater, however, a number of private wells are located in the planning area.

2. Wastewater Treatment in the Planning Areas

a. The City of Bloomington

The City of Bloomington presently has two sewage treatment plants (STPs). The north drainage area is served by the Blucher Poole STP. This plant has a design capacity of 6 MGD with approximately 2/3 (2 MGD) of the present 3 MGD flow being pumped via force main from the south drainage area. The treated effluent is discharged to Bean Blossom Creek. The south drainage area is served by the Winston Thomas STP which has a design capacity of 7 MGD and hydraulic capacity of 10 MGD. Flows in excess of 10 MGD receive primary treatment and are diverted to a 16 acre lagoon while flows in excess of 14 MGD by-pass the STP and go directly to the lagoon. Discharge of treated effluent is to Clear Creek (Clear Creek has a 7 day once in 10 year low flow of zero). This STP was built in 1934 and expanded in 1955 and 1969.

The Winston Thomas STP is difficult to operate efficiently and is frequently overloaded (1974 average daily flow was 11.2 MGD). The municipal waste laods, flows, treatment efficiencies, metal content of sludges, D.O. conditions in the receiving streams and effluent permit standards for the proposed facilities are in Appendix A. Building a new sewage treatment plant to serve the South Bloomington area has a state priority number of 14.

b. The Lake Monroe Regional Waste District

Package STPs and septic systems presently serve the LMRWD. The present flow to package plants during the summer season is approximately .2 MGD. The projected summer flow in 20 years from the Lake Monroe Regional Waste District is estimated to be 1 MGD. Constructing an STP to serve the LMRWD has a state priority of 139. Listed below are the point source discharges within the LMRWD.

Facility	Development	Capacity	Discharge To
1. Hardin-Monroe, Inc.	16 Residences	6,000 G.P.D.	Lake Monroe
2. Hardin Ridge U.S. Forest Service	Camping Area	40,000 G.P.D.	Lake Monroe
3. Boy Scout Camp	Scout Camp	6,500 G.P.D.	Lake Monroe
4. Salt Creek	Residences	15,000 G.P.D.	Lake Monroe
5. Paynetown Recreational State Dept. of Natural Resources	Camping Area	43,700 G.P.D.	Lake Monroe
6. Water Filtration Plant City of Bloomington	Sludge Lagoon Overflow	19,200 G.P.D.	Lake Monroe
7. Fairfax Recreational Area State Dept. of Natural Resources	Camping Area	46,100 G.P.D.	Lake Monroe
8. Flood Control - Dam U.S. Corps of Engineers	Office & Overlook at Dam	10,000 G.P.D.	Salt Creek
9. Caslon STP	The Pointe	115,650 G.P.D.	Clear Creek

A major concern of the existing sewage discharges to Lake Monroe is their effect on water quality. The Aquatic Ecology section of the Lake Monroe Land Suitability Study provides detailed information on existing physical-chemical and biological conditions in Lake Monroe and is reproduced in Appendix B. (The sewage treatment plant in Nashville, Indiana discussed in Appendix B, is not in the planning area under consideration in this EIS. However, the poor quality effluent reported for

Nashville which flows into Lake Monroe is based on 1968-1972 data. The effluent quality should be changed significantly as a result of expansion during 1975 of the Nashville STP to .25 MGD and a general upgrading of the facility.)

The largest point source discharges to Lake Monroe within the LMRWD are Paynetown, Fairfax and Hardin Ridge Recreation Areas. Although no monitoring of effluent quality was done for Paynetown and Fairfax Recreation Areas, the state of Indiana has authorized the construction of an interceptor that diverts the flow of the Fairfax Recreation Area from Lake Monroe to the Caslon STP for treatment with subsequent discharge to Clear Creek. This action will eliminate the most significant treated sewage discharge to Lake Monroe in the LMRWD. Based on existing water consumption, the discharge effluent from Paynetown is seasonal with the peak flows of approximately 30,000 GPD during the summer. Effluent quality information for Paynetown was not monitored and as a result no detrimental effects on Lake Monroe are known due to discharge from the Paynetown Recreational Area. Constructing an interceptor to serve the Paynetown Recreational Area is considered in this EIS.

The Hardin Ridge Recreation Area is located on the east side of Lake Monroe and regionalization with other facilities is presently not economically feasible, nor is it necessary based on the effluent quality found in Appendix C. Elimination of poorly functioning septic systems in the LMRWD by constructing sewerage facilities is desirable only when sewering an area is the most cost effective method to solve the problem. Documentation of the severity of existing septic system problems and alternate costs of solving those problems should be evaluated by the LMRWD prior to its decision to construct sewers to replace septic systems.

c. Polychlorinated Biphenyls (PCBs) in the Winston Thomas STP System

PCBs have been detected in raw sewage of the Winston Thomas STP. Monitoring efforts are underway by EPA to determine the sources and concentrations of PCBs and the appropriate action that should be taken to correct the problem. Background information on PCBs is discussed in a July 1975 paper by EPA titled "Statement of Concerns of the Lake Michigan Toxic Substances Committee Related to Polychlorinated Biphenyls".

E. Other Water Quality and Quantity Objectives

1. The Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) require:

   a. Secondary treatment of wastes for municipal sewage and best practicable treatment for industrial discharges by July 1, 1977.

b. Best practicable waste treatment technology for municipal wastes and best available treatment for industrial wastes by July 1, 1983, and form the basis for design of projects funded by EPA from FY 1975 or later allocation.

c. All point-source discharges require a permit under the NPDES program (National Pollutant Discharge Elimination System). The NPDES permit states the allowable waste loading and flow volume that can be discharged to a receiving stream, lake or ocean.

2. The National Flood Insurance Act of 1968 requires the designation of flood-prone areas in the United States (based on 100 year flood) and participation by the appropriate communities and homeowners to qualify for national flood insurance protection.

   Portions of the Bloomington Metropolitan Area have been mapped for flood prone designation and HUD is presently pursuing appropriate public comment procedures prior to issuing an official 100 year flood-prone map.

3. A Lake Monroe Land Suitability Study has been published by the school of Public and Environmental Affairs, Indiana University. This study evaluates existing environmental conditions in a 100 square mile portion of the Lake Monroe Watershed, identifies issues that need to be considered in planning for future changes in the study area, and summarizes the institutional framework that affects land use and water quality decisions for the Lake Monroe area. The executive summary of this study is found in Appendix D.

F. Cost and Financing

Detailed costs of the various alternatives are summarized in Chapter 3 Table 6. The funding of the recommended proposal would be apportioned as follows:

1. 75% federal funding of eligible project costs

2. 10% State of Indiana funding of eligible project costs

3. The local communities must provide the capital to pay the remaining costs.

G. History of Application - Sewage Works Projects: C180560-01 and C180-561-01

- June 3, 1974 Application for facilities plan grant submitted to the State of Indiana

- July 9, 1974 "Facilities Plan Agreement" between the City of Bloomington and the LMRWD for conducting a facilities plan.

- August 20, 1974 Revised application for facilities plan grant submitted to State of Indiana.

- September 12, 1974 Application for completion of Sewer System Evaluation Survey (SSES) (C180561-01) submitted to State of Indiana.

- October 25, 1974 State of Indiana conditionally certified application covering June 3, August 10, and September 12, 1974 applications.

- December 20, 1974 State of Indiana certified the Facilities Plan segment and SSES to EPA.

- January 22, 1975 Meeting at Region V offices in Chicago to discuss deficiencies in facilities plan with City of Bloomington, LMRWD and Black & Veatch.

- March 20, 1975 Black & Veatch transmitted 1st Amendment to Facilities Plan to EPA.

- May 14, 1975 EPA issued notice of intent to prepare an EIS on the South Bloomington - Lake Monroe Facilities Plans.

- May 29, 1975 Environmental Assessment hearing by the City of Bloomington Utilities Service Board on the Facilities Plan in Bloomington.

- June 25, 1975 EPA made grant award to City of Bloomington for facilities plan preparation subject to supplemental information which might be requested during EIS process.

- July 14, 1975 Gilbert Associates commences preparation of an analytical report on South Bloomington, Indiana - Lake Monroe EIS issues.

- July 16, 1975 EPA Holds community information meeting to explain EIS Process, to identify key issues on the proposed wastewater treatment facilities and to announce preparation of analytic report by Gilbert Associates.

- November 7, 1975 Gilbert Associates transmits preliminary analytic report to EPA.

- December 4, 1975 EPA summarizes preliminary findings of GA report in letter to City of Bloomington, see Chapter 6.

- December 23, 1975 GA submits final report to EPA.

- January 17, 1976 EPA approves and releases final report of GA.

H. Issues Evaluated:

1. Regionalization - should there be one STP to serve the South Bloomington and Lake Monroe areas or separate STPs?
2. Evaluation of the pure oxygen wastewater treatment process for all regional plants as contrasted with the activated sludge process.
3. The desirability of renovation and expansion of the Winston Thomas STP.
4. The capacity(ies) and location(s) of a regional STP or separate STPs as determined by existing needs and projected populations of the South Bloomington and Lake Monroe areas.
5. The tradeoffs involved in constructing a treatment plant on sites along Clear Creek with a 5 BOD , 5 SS effluent vs. the Salt Creek site with a 10 BOD 10 SS effluent.
6. Present Worth Analysis of alternatives.
7. Distribution of Costs.
8. The process of sludge treatment and disposal best suited for the wastewater treatment facilities recommended.
9. The full range of environmental impacts in implementing the various alternatives.
10. The induced growth implications for the Lake Monroe Area if one regional STP is constructed.
11. The mitigative measures that can be implemented to minimize undesirable physical environmental impacts.

The above issues are evaluated in Chapters 3 and 4. They are organized by tasks corresponding to the order in which they are identified. Tasks 1-8 are in Chapter 3 and tasks 9-11 are found in Chapter 4.

CHAPTER 2
THE ENVIRONMENT WITHOUT THE PROPOSED ACTION

A. General

The planning area consists of three regions referred to as the north, south, and Monroe Reservoir service areas. The proposed new wastewater treatment facilities will primarily affect the south and Monroe Reservoir service areas.

The south service area consists of most of the City of Bloomington and the lower Clear Creek drainage area. Approximately 28,230 acres of developed land or land suitable for development are contained within the City and the surrounding fringe areas south of the City. It is anticipated that residential development will continue to expand into this area.

An additional 24,300 acres are contained in the lower Clear Creek area located between Dillman Road and Salt Creek. This area is sparsely populated farm land, with several stone quarries scattered throughout the area. Extensive development is not anticipated in this area during the period considered in this study. Concentrated development is more likely to occur in areas adjacent to the City of Bloomington and near Monroe Reservoir.

The Monroe Reservoir service area is located about 8 miles southeast of Bloomington. The reservoir covers approximately 10,750 acres of the total 40,000 acres within the Lake Monroe Regional Waste District boundaries. Some of the area has rugged terrain and limited development has occurred. The area is subject to extensive recreational use, especially over holiday weekends. Greater detail on the Lake Monroe Area is found in Appendix **D** .

B. Detailed Description

1. Climate

Indiana has a climate of warm summers and cool winters. Bloomington has a mean maximum temperature in January of 42° F and in July of 89 F. The annual mean temperature is 55.3° F and the annual mean precipitation is 44.04 inches.

2. Topography

The area in the vicinity of Clear Creek between Bloomington and the confluence of Clear Creek with Salt Creek is rugged and characterized by steep land slopes. The rugged topography limits the potential treatment plant sites south of Bloomington. There are relatively few areas which have sufficient level ground to allow construction of a treatment plant adequate to handle existing and future neeeds. The few level areas available are generally dissected by a railroad track, roads, or Clear Creek. The rugged topography also influences the location and the difficulty of construction of the main interceptor for the proposed wastewater treatment facility.

3. Geology

Bloomington and its immediate surroundings are located in the northern portion of the famous Bedford-Bloomington limestone area. It is an important mineral producing area, with many stone quarries and milling opeqations. Four limestone formations (Harrodsburg, Salem, St. Louis, and St. Genevieve) underlie much of the central and western portions of the county. Weathering of this limestone has resulted in the formation of the long, narrow karst plain that extends from northwestern Monroe County all the way to Kentucky.

The limestone bedrock which extends the entire length of Clear Creek will complicate the construction of the main interceptor sewer. It will require use of explosives in the construction of the sewer.

4. Soils

Soils in the areas underlain by the limestone have extremely variable thickness and are a function of topography. Three general geologic soils types are present: residual, colluvial, and alluvial. Most soils in Bloomington and vicinity are of residual and colluvial origin and are derived largely from the weathering of limestone. Residual soils are those that were formed in place by progressive weathering of rock. Colluvial soils were formed by accummulations of the soils from higher slopes sliding downhill. Colluvial soils are generally thicker, less homogeneous, and less well compacted. All four limestone formations are overlain by residual soils on the flat upland slopes, but colluvial soils are dominant on the steep slopes of the valleys near stream level. Most colluvial areas, however, are characterized by gently rolling topography without steep slopes. Alluvial soils are soils deposited by moving water and are found only in the large stream valleys.

Subsoils in the upland areas are moderately to slowly permeable, depending upon topography. Soils in the Salt Creek and Monroe Reservoir areas are underlain by relatively impervious siltstones and shales.

5. Water Resources

As in other limestone regions, water from ground supplies or issuing from springs is not filtered as well as water taken from sand or gravel aquifers. Pollution of the ground water supply by infiltration from septic tank drainage fields and polluted surface waters can be a serious problem. Unfavorable geologic conditions require deep wells drilled through bedrock and generally such wells do not yield adequate quantities of good-quality water for household use. For this reason, most rural development is served by rural water districts that purchase water from the Bloomington municipal water system which utilizes surface water supply sources. At the present time there are no municipal water supplies in Monroe County using ground water. However, a number of private wells are located in the planning area.

Surface drainage is distinctly different in the central and western areas of the county as compared to eastern areas. Drainage in some parts of the limestone region is through underground passages or into small streams ending in sinkholes. Surface drainage in the east and southeast areas of the county is more clearly defined. The area is severely dissected by stream beds cut deeply into the bedrock. The high runoff rates in this area cause minor flooding problems on the lower reaches of Clear and Salt Creeks during periods of heavy rainfall.

There are no natural lakes in Monroe County. Reservoirs, water-filled quarries, and ponds, however, are scattered throughout the area. Lake Lemon and the Monroe and Griffy Reservoirs are used extensively for recreational purposes and also serve as municipal water supply sources for most of the county.

6. Parks and Historical Sites

There are no parks or prominent historical sites within the limits of the proposed project. There are state and national forests along the eastern part of Monroe Reservoir. There are also recreational areas adjacent to Monroe Reservoir to the east of the Salt Creek Site.

7. Cemetery

A cemetery is located near one of the potential treatment plant sites. It is east of Victor Pike and slightly more than one mile south of Dillman Road. The cemetery would be within about 250 feet of the Ketcham Road site, but would be separated from the plant by Clear Creek.

8. Environmental Constraints

Topography and geology are factors which place serious constraints on the project. The rugged terrain and existing development limit the number of potential treatment plant sites. The prevalence of rock throughout the area will complicate construction of a connecting main sewer for all sites except Winston Thomas and South Rogers.

The quantity of water available for effluent dilution is another consideration. A higher degree of treatment must be provided for a plant located on Clear Creek due to the lack of dilution water during low flow periods.

Provisions must be made to protect the treatment facilities from floods. Levees can be provided for flood protection for the 100 year flood level. The flood protection measures must not result in excessive restriction of the flood plain.

9. Air Quality

The air quality in the Bloomington area (based on the monitoring station at 4th and Walnut Streets) is within the ambient air quality standards. Air sampling frequency distributions and the ambient air quality standards are found in Appendix E .

CHAPTER 3
ISSUES & ALTERNATIVES

TASK 1*

EVALUATION OF REGIONALIZATION/PROJECTED POPULATION AND LAND USE PATTERNS

1.1 ISSUES, BASIC ASSUMPTIONS AND FINDINGS

The regionalization issue, which would probably result in one large plant at Salt Creek to serve the South Bloomington Service Area (SBSA) and the LMRWD, hangs upon the demand and need for sewering Lake Monroe. There is no other apparent reason for treating sewage some eight miles from its major source, the Bloomington Area. As such, the decision becomes, in the Consultant's opinion**, more of a politcal than an engineering one, for the analysis of the issues and related considerations raises some serious doubts as to the need for sewering the Lake Monroe area.

A desire for the improvement of the economic climate may be the sole reason for the lakewide sewer system, which would aid in opening the lake area for development. Even if this sytem could be financed by tying it into the Bloomington Sewer System and thereby spreading the cost of this economic development program over a wider population (the Bloomington Urban area), it would still be prudent to defer such action until the environmental effects of development can be better evaluated in light of the lake's ability to accommodate such change. Lake Monroe is too valuable a natural resource and asset to the area to treat it like a commodity.

If Lake Monroe were not served by a lakewide interceptor sewer system, the Salt Creek Plant site location and regional scheme would not be necessary. Both the Lake Monroe and Bloomington 201 Plans recommended this regional plant and the lakewide interceptor system. The latter system was sized and designed to facilitate seasonal, second home and resort complexes proposed at various locations around the lake.

There is no absolute answer about the need for sewering the lake. Data given the Consusltant was not in sufficient detail to conclude that a regional waste treatment system is economically feasible, when in fact it might be needed, or who might be participating in its financing. This system, as designed, consists of a force main collector. Therefore, economically speaking, it will only be available to rather large developments, those which can underwrite the temporary treatment facility depreciation and provide for the pumping and other extra costs necessitated by such a system. These potential second home and resort developers were unable, for the most part, to respond to the LMRWD Consultant in sufficient detail to ascertain a timetable for construction. In effect, this system would be planned for developments which have not been scheduled and may never be constructed.

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* Pages in Chapters 3 & 4 are numbered as follows 1st digit = chapter #, 2nd digit = task # and 3rd digit = page #.

** The (Consultant's opinion/Consultant) not explicitly identified in Chapters 3 & 4 is Gilbert Associates.

The attempt to determine the potential seasonal housing market at Lake Monroe produced unsatisfying and somewhat inconclusive results. There are too many significant variables affecting this market. One aspect is that it would be possible to purchase a housing unit located on the lake but not in line of sight with the lake, nor having any access for swimming or boating except at designated public facilities such as Fairfax State Park. This holds true for all developers except the State of Indiana. At present, the State leases land from the U.S. Army Corps of Engineers, with full property rights including direct lake access. The State, in turn, is able to sublease land, and has done so for commercial development such as the Four Winds Marina. There is no way of determining what the State will do in the future; but theoretically, the State is in a more advantageous position than private developers with respect to the market and inducing development. It is possible that with the present market uncertainity, it is the market and not the sewer system that may prove to be the more central issue in Lake Monroe's development future.

There is one seasonal/second home development now under construction and it has its own temporary sewerage treatment facility. This development, The Pointe, is a planned community of some 1400 units. At its present rate of completion, The Pointe may not be completed until after 1990. The Pointe is a first class seasonal-recreational facility; and it has advantages that other developers may not be able to equal, such as lake access thorough the Marina.

In the course of this independent analysis, the Consultant was able to locate individual demand centers or areas of sufficient population size and densities felt to warrant sewerage service. In addition, these demand centers were evaluated with respect to their geographic and hydraulic location to one another with a view toward determining their potential relationship to service from alternative site locations. It was not possible, with the data available at this time, to ascertain economic feasibility of alternative total systems for servicing Lake Monroe. The Consultant* is of the opinion that such feasibility studies are premature considering that it is not known for certain how, when and where sewerage service will be needed around the lake. This preliminary analysis was helpful in suggesting some alternate possibilities for handling the major sewerage demands within the Lake Monroe area. The major demand centers in the Lake Monroe Area are shown on Plate 4.

The major sewerage demand in the Lake Monroe area consists mainly of year-round housing located in several of the older hamlets. One grouping, the Sanders-Smithville area, could actually be better served at the Dillman rather than the Salt Creek Site. Harrodsburg fits in with the Salt Creek Site location but could just as well be served at The Pointe's facility. The sewering of these older areas would be more desirable in the event of the documentation of on-lot disposal system failures within these older settlement areas.

* Gilbert Associates.

Some areas around the lake, particularly near the causeway, are actually located closer to the Winston Thomas site than the Salt Creek Site. On the south side of the lake, the developments could probably treat their effluent outside the lake drainage district; although some of these proposed developments are too small to reasonably expect service.

Even if it were determined that serving the Lake Monroe area would induce immediate development, sufficient doubts have been raised about the environmental effects of such development to warrant further study before taking action.

1.2 POPULATION AND FLOW PROJECTIONS

Since people create the demand for sewerage service, it is important not only to carefully match the rate of population growth to the sizing and scheduling of sewer development, but also to coordinate sewer system development with anticipated changes in land use activities to maximize the benefit of that improvement.

Any projection, whether demographic, economic or social, is based upon a multitude of assumptions and value judgements as to the reasonable expectations for the future. Demographic projection is not a science, because the future will consist of those events and changes that cannot be forseen as well as those that can. The only certain thing is that conditions underlying projections can, and often do, change overnight.

Since the preparation of the Bloomington and the Lake Monroe Regional Waste District 201 Plans, some changes have occured in local growth assumptions regarding the university, industrial trends, and other factors that warranted independent analysis to determine what, if any, significance these changes might have on flow calculations. In addition, the original population analysis outlined in the 201 Plan was not organized in a manner suitable for evaluation of alternative regional schemes. Considering this situation, the Consultant decided to independently prepare population and flow projections as an aid in evaluating regionalization.

1.2.1 Summary of Findings

The following paragraphs describe the methodologies, procedures and assumptions used by the Consultant in developing projections and estimates of flows.

The Bloomington 201 Plan estimated increases in residential and student populations, industrial jobs, and commercial activities to determine flow increments; adding to these projections those of the Lake Monroe 201 Plan.

The Consultant, in preparing independent projections, used a similar projection method and flow parameters as found in the Bloomington 201 Plan.

Figure 1-1 shows a comparison of various population projections for Monroe County.

Using quite different growth assumptions and expectations for flow increases in the residential, industrial and university segment, the results only varied 10% from those in the Bloomington 201 Plan as amended.

Table 1-1 summarizes the differences in flow calculations between those of the Bloomington 201 Plan and this Consultant. The existing flow figure of 11.2 MGD does not include the total flow from the south now pumped north and treated at the Blucher Poole plant. The Bloomington 201 Plan recommended that this pumping be discontinued, but this Consultant feels that there are compelling arguments for its continuation. Therefore, for convenience of comparing the two calculations in Table 1-1, the current Blucher Poole flow was deleted from the southern regional plant sizing consideration. The rationale for this recommendation is the excess capacity at the northern plant and the fact that the use of this capacity will aid in producing a better effluent and allow more efficient operation. In addition, the lower level of treatment required at the northern plant means that it will more than likely be operated at an equal or lower cost than a new regional facility, even considering the minimal extra costs associated with pumping.

In the case of Lake Monroe, it was extremely difficult to corroborate the expectations for a sewage flow of 3.0 MGD. Instead, a near term flow estimate of 1.0 MGD was used in the alternative comparison.

1.2.2 Flow Variations

To adequately understand the differences between flow projections in the 201 Plan and those developed by this Consultant, it is necessary to understand the various drainage and jurisdictional areas within Monroe County. The boundaries of these areas are shown in Figure 1-2. The flow comparisions indicated in Table 1-1 are shown graphically in Figure 1-3.

1.2.2.1 Residential

Local agencies indicated that the Bloomington 201 Plan County projections for the county were quite high as evidenced by Figure 1-1. In addition, the 201 Plan considered the entire population living south of the drainage divide to be "contributory to" and therefore to be served by the regional sewer system. But, in fact, there are extensive areas within Monroe County that will not be economical to serve in the foreseeable future. Both of these differences would tend to reduce the original 201 estimate, but they were offset by other considerations. First of all, local planning officials did not agree that such a high percentage of the total county population (even if overstated) would be located in the northern section of their jurisdiction, instead of the south and southeast areas, the more traditional growth areas. Secondly, the local planners envision more of the total population residing within range of future sewers. Even with these differences, the overall difference between flow calculations as shown in Figure 1-3 was not too significant, particularly considering that this Consultant used the City Planning Commission's more conservative growth projections.

The differences between flow calculations in the case of Lake Monroe are more at variance and are documented in this task and in Task 10, Induced Development - Lake Monroe. The Lake Monroe 201 Plan assumed that all the population within the district and all the seasonal developments would be served. This Consultant's review indicates that it is almost impossible to predict the lake resort seasonal and resort prospects based on available information.

The differences between this Consultant's and the Lake Monroe 201 Plan projections are quite significant, and are rooted more in basic assumptions than in differences in opinions as to rates of growth and household sizes.

The Lake Monroe 201 Plan assumed a rather rapid rate of population growth for the lake area, presumably in anticipation of a forthcoming real estate boom. The future of the Lake Monroe area in terms of population growth lies in the seasonal and second home market. While the 201 Plan treated all the plans submitted to date as if they would be built, this Consultant feels that with the particular situation at Lake Monroe and the current market, this assumption cannot be corroborated. This consultant assumed, based upon the details presented later in this text, that the south side of Lake Monroe and even the causeway area did not at this time justify service, and furthermore, that the entire interceptor concept would be quite an expensive system. Passing on added costs of an expensive sewerage system would in turn affect the competitiveness of each project.

1.2.2.2 Industrial

The main difference in the industrial flow calculations is that the Bloomington 201 Plan inadvertantly used Region 10 overall economic employment projections as an industrial employment projection for Monroe County.

1.2.2.3 Indiana University

University officials indicated that they anticipated the enrollments to peak prior to construction startup and decline thereafter. As a result, this Consultant did not consider the university as having any future increase.

1.2.2.4 Commercial

As an independent check, this Consultant calculated commercial flow at 50 gallons per person daily. With an anticipated 19,000 more people to be served by the year 2000, an increase in commercial flow of about 1.0 MGD might be expected rather than the 0.8 in the 201 Plan.

1.3 POPULATION PROJECTIONS/DEMAND CALCULATIONS

1.3.1 Introduction

The population projections for Monroe County from the 1974 Bloomington Facilities Plan anticipate a significantly higher rate of growth than projections from either the Bloomington City Planning Commission or the Bureau of Research in the Indiana University School of Business. Personal interviews with officials in both agencies substantiate this disparity.[1] The variation in population projections is shown in Figure 1-1.

Population projections reflect basic underlying assumptions regarding birth, death, and migration rates. The Bloomington 201 Facilities Plan population projections are thought to be based upon pre-1970 census data embodying underlying assumptions such as a continuation of Monroe County's population increase commensurate with its share of 1960-1970 population growth which represented 90 percent of the total of Economic Region 10.[2] However, during the 1960-1970 period, several changes occurred that were responsible for Monroe County's accounting for such a large share of Region 10's population change, and local authorities do not feel that these events will reoccur in the future. These changes included doubling of University enrollments and a rapid increase in manufacturing jobs resulting from the relocation of the Otis Escalator Plant, employing 1000 persons, into the area. In addition, the 201 Facility Plan projections were based on pre-1970 birth rate trends which would result in a much higher population level than if current birth rates were utilized.

1.3.2 Alternate Projections/Bloomington 201 Plan

1.3.2.1 Indiana University School of Business, Bureau of Research

One set of alternate population projections was prepared by the Indiana University School of Business, Bureau of Research. While these projections incorporated more current birth rate trends, they do not offer a fair comparison due to the manner in which university student population was projected. The methodology used was a five year age-sex, cohort-survival method; but student populations were aged forward rather than replaced as the overall population was aged forward for each five year period. As a result, by 1990 the 15-24 age group, where one would expect to find most university students, was one third the size of that age group in 1970. The 1970 university student population being aged forward resulted in an abnormally large 35 to 44 year age group by the year 2000. While these two errors may offset each other, the resulting projection is significantly lower than if the error was not introduced.

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[1] Bloomington City Planning Commission; Indiana University, Bureau of Reasearch School of Business.

[2] Includes Monroe, Owen, Lawrence and Greene Counties.

1.3.2.3 Bloomington City Planning Commission

Another source for locally prepared population projections is the Bloomington City Planning Commission. This agency is responsible for the planning and land use control for the more populated portion of Monroe County, the Bloomington jurisdictional area. This Commission is now in the process of preparing a report dealing with future population growth within the Bloomington area. It was the lead agency responsible for discovering, among other census irregularities, that the 1970 census total population was greater than that reported.

The city has prepared population projections for its jurisdictional area as well as for Monroe County. These projections consist of a high and low series reflecting somewhat different birth rate levels and are quite conservative in comparison to the Bloomington 201 Plan. The reason for this wide disparity is that the basic underlying growth assumptions in the city's projection run contrary to those of the 201 Plan. The former assumes a reduced birth rate commensurate with current trends, a much slower rate of economic growth, and anticipates university population stabilizing in the very near future. The City Planning Commission projections are more attuned to the areawide 1950-1960 rather than 1960-1970 growth trends. They consider the latter period to be atypical due to birth rate levels, the university enrollment explosion, and the rather rapid growth of industrial employment.

Their Monroe County projections ranged from a low of 95,000 to a high of 110,000 by the year 2000, from a 12 to 30 percent increase. For comparison purposes, the average population change anticipated was used. The city's high estimate is about ten years behind the population levels envisioned in the Bloomington 201 Plan, while the city's low estimate was twenty years behind the same 201 Plan forecasts.

The Bloomington 201 Plan envisions Monroe County to increase in its population by 62 percent by the year 2000 versus a more modest 21 percent envisioned by the city. Certainly, neither projection will be absolutely correct. Short term trends evident today, such as greatly reduced birth rates, slow growth in university enrollment, and less than dynamic economic conditions would appear to lean more toward corroborating the city's growth assumptions rather than the 201 Plan's.

Intercensal population estimates for Monroe County pinpoint the county's 1973 population[3] at 89,806 persons. If these figures are reasonably accurate, then the short term county population growth rate trend would more clearly approximate those in the Long Range Water and Sewer Plan for 1980. If this estimate is on course in context of the long run period, then even the city's high projection would appear to be somewhat conservative, while the 201 Plan would still fall on the high side.

1.3.3 Adjustments to Projections/1970 Under Reporting

Both the 201 Plan and the City Planning Commission projections were estimated without the benefit of adjusting for 1970 census under reporting. While it is fairly evident that the 1970 city and, therefore, county population was actually larger than reported, by how much has not yet been definitely determined.

If the city's projections are adjusted upward by 6000[4] persons the city's high side population projection fits remarkably well with the curve in the Long Range Water and Sewer Plan, while the adjusted average would approach the former high population projection. The average adjusted projection was utilized herein as an independent population projection to compare with the 201 Plans.

1.3.4 Projected Population Distribution

The Bloomington 201 Plan not only assumed a faster rate of population growth within the county, but a somewhat different distribution of population than envisioned in the city projections; and more importantly a somewhat larger population "contributory to" the southern area.

The Bloomington 201 Plan distributed future population change almost equally between locations north and south of the major drainage divide running through the center of the city. Under this allocation, the northern area, which accounts for about 20 percent of the 1970 population, would account for 33 percent of the total county population by 2000. In this regard, the 201 Plan also anticipates a more rapid rate of development for this northern area than did the City Planning Commission. The Planning Commission expects the major thrust of new residential development to continue within the southern and southeastern sectors of its jurisdictional area. One reason the city[5] offers for this is that the northern section of the Bloomington jurisdictional area is restricted by flood plains, steep slopes, limestone problem areas, quarries, existing industrial development, and city and university ownership of large tracts of land. These factors are significant constraints to residential development. This is in contrast to the less physically restricted traditional south and southeast growth corridors.

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[3] Table 1. Population 1970 and 1973, and Related Per Capita Income (PCI) for Revenue Sharing Area, U.S. Bureau of Census.

[4] See paragraph 1.3.6.1, Census Discrepancies.

[5] Conversation with the Bloomington City Planning Commission Staff.

The portion of the northern drainage area that has recently reported rapid population growth is the Elletsville area which is located beyond the Bloomington jurisdictional area. Elletsville has its own sewer system which has apparently already reached its capacity. The City Planning Commission is of the opinion that the lack of additional sewage treatment capacity there would tend to limit growth of Elletsville.

While the City Planning Commission has not yet allocated its population growth projections, it does not anticipate a widening gap between the proportion of population north and south of the drainage divide. Instead, the City Planning Commission is of the opinion that the present 20/80 percent distribution of population is likely to continue in the future. Therefore, even using the City Planning Commission's population projection for Monroe County for the year 2000, which is 30,000 persons below that shown in the Bloomington 201 Plan and the city's distribution assumptions, it is apparent that some 7,000 fewer people would reside in the southern drainage district in the year 2000 (Table 1-3).

1.3.5 Population Distribution and Sewer Service Areas

The Bloomington 201 Plan used the total anticipated change in population for all areas of the county located south of the major drainage district in determining incremental increases in sewage flows, even though some of this population was located within drainage areas not planned to be served by future interceptors.

The Bloomington 201 Plan referred to some 63,000 persons as residing "contributory to" the southern drainage district, with 90,000 people anticipated by the year 2000. Not all of this population will be served by sewers by the year 2000 regardless of the plant site location; however, the 25,000 persons increase was used in the Bloomington 201 Plan to calculate increase in future sewage flows.

With this in mind, the Consultant, using U.S.G.S. 7-1/2 minute quadrangle sheets and counting houses, attempted to determine existing population distribution with the natural drainage area that would be served by the southwest and southeast interceptors--the two interceptors planned for construction within the 20 year planning period for the proposed plant. A part of the southeast drainage area even goes far enough south to include a part of the District Service Area[6] of Lake Monroe Regional Waste District.

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[6] Lake Monroe 201 Plan.

Based on the foregoing analysis, it was determined that only 70 percent of the 1970 population residing south of the major drainage boundary actually resided within any of these natural drainage districts: the central, southeast and southwest. This percentage should be adjusted upward to 80 percent taking into account the 1970 census under reporting.

The Consultant assumed that this southern drainage area, noted by the City Planning Commission to be the major growth area within its jurisdictional area, would attract an ever increasing percentage or share of population growth in the future. Although not definitively ascertained, this proportion was anticipated to increase from 80 to 85 percent by 1990.

The Consultant, using the city's growth projections, calculated an 18,000 person increase within the combined central, southwestern, and southeastern drainage areas. At an average sewage flow of 100 GPCD this would add 1.8 MGD rather than 2.5 MGD to southern sewage flows. This calculation does not yet include consideration for the Lake Monroe waste district flow increases.

1.3.6 Variances with Bloomington 201 Plan Projections

1.3.6.1 1970 Census Discrepancies

The 1970 census count for the City of Bloomington and the south drainage flows should be adjusted upward by 5,000 to 6,000 persons to reflect census discrepancies. This would directly affect all previously prepared population projections such as found in the Bloomington 201 Facility Plan by enlarging the population base quite significantly, amounting to an equivalent of 1/6 of the city's total 1970 population. Not all of this error is within the City of Bloomington, but most of it is certainly located within the southern drainage districts.

As well as can be determined, this under reporting occurred primarily within the university student population. The 1970 census was self-reported so there is no way to definitively determine the extent of under reporting with the data at hand, but the calculations in Table 1-5 provide at least an estimate of the magnitude of total error. From this cursory analysis, it appears that about 8 percent of the university student population probably commutes to and from the university from locations outside Monroe County.

1.3.6.2 Indiana University Enrollment Trends/Flows

The university is the city and county's largest single industry. A good share of the 9,714 persons employed by public and private schools within the county owe their livelihood to the university.

The 30,370 student population in 1970 was equivalent to 3/4 of the city's population as reported in the census. Adjusting for suspected discrepancies, the university student population accounts for 2/3 of the city's total population.

Current and future university enrollment trends indicate that the Indiana University enrollments will peak prior to 1979-1980 school year. After this the enrollment may stabilize or even decline slightly.

The unofficial 1975 enrollment at Indiana University is expected to fall within the range of 31,000 to 32,000 students.[7] An average of 31,500 students would indicate an increase of 1,132 students, a rate of change less than a 1% per year since 1970. At this rate of change, enrollment may peak out at approximately 32,350 students in the 1978-1979 school year; some 2,500 fewer students than anticipated in the Bloomington 201 Plan.

These enrollment projection rates may be slightly overstated considering the current economy. The university noted a one to two percent higher ratio of enrollment to the total state population age pool that the university draws upon for its enrollment and apparently a higher proportion of undergraduates remaining for graduate work. This condition is felt to reflect current employment opportunities and will probably not become a permanent condition. It is quite possible that university enrollments will actually decline in the 1980's as a reflection of the current statewide decline in the size of the elementary and secondary school age group.

There are no known absolute limits to long term enrollment changes at the Bloomington Indiana University campus. The university owns considerable acreage upon which to expand. There are, however, practical short term limits. At present, the university is faced with a limit in the amount of classroom capacity.[8] With the immediate prospects for declining enrollments, it is not very likely that the State of Indiana will be entering upon any new era of university enlargement in the near future.

With an anticipated 1978-1979 enrollment increase of less than 2,000 students over the 1970 levels, increase in university flows may be closer to .09 MGD rather than the .2 MGD increase projected in the 201 Plan. In fact, considering that university enrollments will have peaked prior to the completion of the sewage treatment plant, and may even decline thereafter, incremental changes in sewage flows from the university may be negligible.

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[7] Telecon with Mr. Shellhamer, I.U. Registrar's Office, September, 1975.

[8] Telecon with Mr. James Perin, Indiana University Budget Office, September, 1975.

1.3.6.3 Economic Trends

The economy of Region 10[9] improved rapidly in the 1960's as a result of the university enrollment doubling and an increase in electrical machinery employment. Otis Elevator located a new factory in the Bloomington area hiring 1,000 persons. Most local sources forsee a slowdown in economic growth, and the future growth prospects for the university appear to be limited. Increases in manufacturing employment normally result more from growth within existing industries rather than relocations, and the probability of another large manufacturing plant relocating to the Bloomington area is felt to be remote.

One reason is that the Bloomington area, particularly the manufacturing sector, is rather limited with respect to labor supply. It is estimated that nearly 1/4 of all 1976 jobs in the Bloomington area were held by residents of other counties and that nearly 1/2 of all manufacturing job opportunities within the Bloomington area were held by outsiders. Any additional labor would have to drive from more distant areas. It appears that from both a labor demand and supply standpoint this area will probably not grow at a very fast rate in the future.

1.3.6.4 Manufacturing Employment Trends

The Bloomington 201 Facility Plan estimate of projected growth of manufacturing employment was based upon employment trends anticipated in an "Indiana Regional and Economic Development and Planning Study."[10] The 201 Plan calculation of Monroe County's share of Region 10's manufacturing employment actually represented the total projected employment increase which includes both the manufacturing as well as the non-manufacturing sectors of employment opportunity.

Increases anticipated in manufacturing flows as recalculated by the consultant are equivalent to about 1/3 that projected in the 201 Plan. Note that the recalculations were taken to the year 2000, while those embodied in the Bloomington 201 Plan were to the year 1990.

1.3.7 Alternate Projections/Lake Monroe Regional Waste District

1.3.7.1 Existing Year-Round Population

Lake Monroe Regional Waste District's 201 plan estimated the district's 1966 population at 5,000 persons in 1,404 household units, assuming 3.7 persons per average household. It was not determined where these 5,000 persons resided nor if they were favorably located with respect to fostering development of an economically viable sewerage treatment system. Also, the plan did not differentiate between year-round and seasonal residential development.

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[9] Includes the counties of Monroe, Greene, Lawrence, and Owen.

[10] Richard L. Pfister, Indiana University, Division of Research, School of Business.

It is desirable to isolate the concentration and distribution of year-round sewage flows from that which might accrue from seasonal, second home, and recreational inputs. This is important because seasonal growth is not directly related to normal economic and population growth factors. Furthermore, there is normally a difference in flow volumes per dwelling unit between these types of units.

The Consultant duplicated the LMRWD methodology, but updated the 1966 housing counts to 1970, and instead of using a blanket 3.7 persons per household, utilized individual 1970 municipal household sizes. This 3.7 persons per household figure used in the 201 Plan is much higher than reported in the 1970 Census. The 1970 figures predate seasonal and second home construction around the lake and are assumed to fairly accurately represent existing year round household sizes.

The results of the recount of population by this Consultant were not exactly similar to the LMRWD 201 Plan figures. Possibly part of the difference might result from the difference in boundary delineations for the Lake Monroe Regional Waste District shown in the two 201 plans. The LMRWD population estimates probably include people residing in the State Route 37 corridor, although this corridor does not appear to lie within the district boundaries. There is no doubt, however, that this corridor should be also served by sewers, especially if Harrodsburg is, since together they represent one of the larger demand centers found within the entire area.

The major demand centers in the Lake Monroe area are shown on Plate 4.

1.3.7.2 Population Distribution/Demand Centers

Suprisingly, the majority of the 3,500 persons estimated by the Consultant[11] to be residing in or contiguous to the LMRWD or within the District's Service Area (Figure 1-2) are located some distance from the lake, principally in older hamlets and villages as distinct from new subdivisions, and not within the district boundaries.

About 1,600 persons resided within the boundaries of the original Lake Monroe regional waste district in 1970; and, more importantly, there were few population concentrations warranting sewer services based on population density or concentration. Most residential developments in the lake district proper consisted of residential development along the ridge roads. Portions of this district population are physically isolated from the rest of the county by Lake Monroe, which is the largest man-made lake in Indiana. Those isolated segments of Salt Creek and Polk Townships are also lightly populated, and these two areas are predominantly forested with some steep terrain. In addition, much of the land here is maintained by the U.S. Forest Service as part of the Hoosier National Park. The only concentration of year-round housing found within the LMRWD was at Harrodsburg.

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[11] Gilbert Associates, Inc.

The District's Service Area (DSA) is located contiguous to and north of the LMRWD boundary. As estimated by Gilbert Associates, Inc., this area contained 55% of the 3,518 persons residing with the combined LMRWD and DSA. The DSA is contiguous to the city of Bloomington jurisdictional area; part of it is also located within the southeast drainage basin of the city. This means that part of the DSA population is favorably located with respect to possible gravity sewage flow to the Dillman or Ketcham sites.

The DSA population is located mainly with the small older settlements such as Handy, Sanders and Smithville. Handy and Sanders are located just at the edge of the city's southeast watershed boundary, but sewage would have to be pumped over this ridge to be treated at any of the Clear Creek sites. However, except in the case of Smithville, these sewage flows would also have to be pumped over ridges to reach the Salt Creek Site.

1.3.7.3 Estimates of Potential Flow From Existing Development

There are two existing residential demand centers that warrant sewering.[12] The largest is the Harrodsburg/State Route 37 corridor and the smaller an amalgamation of the small hamlets located in the DSA. Discounting the isolated and scattered residential developments typical in the area, it is estimated that less than 2,500 persons reside in areas of favorable density and in locations that warrant near term sewerage service. This figure also includes 600 persons outside the district in the State Route 37 corridor. Another .12 MGD should be added to this estimated .24 MGD year-round residential flow to reflect contributions from the three elementary schools and recreational flows from Fairfax State Park.

1.3.7.4 Year-Round Population Projections

In the LMRWD 201 plan the population increase was assumed to be an average annual rate of 3.47% per year. At this rate Monroe County would have a population of 180,000 persons by the year 2000. This rate of growth even exceeds that found in the Bloomington 201 Plan which is itself probably overstated. At this rate, the Bloomington 201 plan population projection of 138,000 would be attained in the mid 1980's; and the City Planning Commission's county projection for 2000 would be attained in approximately 1977.

Current population trends within the district reflect a turn-around from 1960 to 1970 population changes (Table 1-9), when the reservoir construction was largely responsible for an estimated 500 person population loss in the townships adjoining the lake. These current 1970-1973 growth trends range from 1.0 to 1.7 percent per annum increase within these lakeside municipalities. The census does not ennumerate seasonal populations so that this increase will not include new recreational and resort projects. These most current figures are, however, only estimates.

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[12] Assuming a minimum of 300 units.

The City Planning Commission population projections estimated a 3,650 person population increase between 1970 and 2000 in that part of the county located outside their jurisdictional area. The corresponding growth rate using their projection is 16.7 percent over the 30 year period. At this rate of increase, the year round district population would enlarge to slightly over 4,000 persons. If the area growth rates were to continue at the 1970 to 1973 levels of approximately 1.5 percent per annum, this area could reach a population level of about 5400 persons.

The same 16.7 and 45.0 percent growth rates for a thirty year period were used to estimate the magnitude of year-round population change anticipated within the Lake Monroe demand centers. It appears from these calculations that year-round residential flows in the Lake Monroe area will be in the vicinity of .30 MGD.

1.3.7.5 Recreational and Institutional Projections

The recreational and institutional flow projections were utilized directly from the LMRWD 201 Plan. It appears that within the time frame in question, the three small schools may eventually be consolidated into one school, the location of which may not even be in the Lake Monroe Regional Waste District. This particular proposition was recently on the ballot for voter approval at a strain Ridge Road location and was voted down.

The only real net increase in recreation flow is projected at the two major state recreation areas--Fairfax and Paynetown. While the Fairfax recreation area is rather favorably located with respect to incorporation with other flow into the Little Clear Creek interim package plant, Paynetown is ill-located - about five (5) miles directly north and east of Fairfax. Without crossing Moore Creek and Ramp Creek inlets, this distance may actually increase to nine (9) miles and the path between is lightly populated.

1.3.7.6 Seasonal Population/Background

Lake Monroe is a Corps of Engineers multi-purpose reservoir, a flow augmentation and flood control reservoir, a major water supplier for the City of Bloomington, and a major state recreational facility. Since its completion in 1965, the lake has been the scene of intense real estate as well as environmental activity. The latter is a response to the real or imagined threat of development indiscriminantly destroying the lake with sewage discharges, coupled with the possibility of construction and operation of developments resulting in an increased sedimentation and siltation, fertilizer runoff, etc.

The State of Indiana passed special legislation to form the Lake Monroe Regional Waste District solely to address the wastewater problem around the lake. This group, in turn, contracted for the preparation of sewerage system plans. In recognition of the linkage between the sewerage service and land usage and environmental effects it also spearheaded a three phase environmental survey and baseline study of Lake Monroe to include a capability model for determining optimum land usage around the lake. This model is not available and the first phase conclusions were preliminary and could not be used in this report.

The Corps of Engineers purchase line for the lake ensures that no one can privately own frontage and have direct access to the lake. Lake access is limited to selected state facilities for boating and swimming, such as Fairfax, Paynetown, etc. Reportedly, this lake line was designed so that views from boats on the lake toward the shore would remain natural looking even if developed. The Indiana State Department of Natural Resources controls the construction of boat docks, slips, marinas, and ramps into the lake. In turn, the quantity of these facilities controls the intensity of boating on the lake.

The major selling point of Lake Monroe from a real estate viewpoint for marketing seasonal home developments is the view and aesthetic appeal, micro-climate of a lake, and relative proximity to boating opportunities. Interestingly enough, the lake itself seems to have very little to do with the only viable development under construction at Lake Monroe - - The Pointe. The Pointe is inward and recreation oriented, built around a golf course, tennis, etc. Lake usage is possibly by special arrangements with the Four Winds Marina or at the State Park, both of which are located off-site. Even at The Pointe, the lake presence or the fact that this development adjoined the lake was not very visually apparent.

1.3.7.7 Seasonal Development Proposals

At present the major private seasonal-resort developments are The Pointe, a planned unit condominium development with a recreation orientation, and the Four Winds, a resort-motel-marina located within Fairfax State Park on subleased land. Quite a few development schemes have been presented for various properties located on the perimeter of the lake. These proposals range from campsites to highly commercial developments such as resort-motels, etc. Very few of these developers could provide a definite timetable or construction schedule to the LMRWD Consultant. Some developments are apparently being held in abeyance unless and until there is a regional sewer system; while others, such as the Inland Steel proposal, have been temporarily or perhaps permanently abandoned.

The Pointe is the only development where construction is in progress and following reasonably close to a construction schedule. Subsequent to the LMRWD 201 Plan, the Pointe constructed a 0.1 MGD temporary package sewage treatment plant along Little Clear Creek.

The existing developments proposed around the lake have selected the west and north side of the lake. This may also reflect ownership patterns since most of Salt Creek and Polk Creek Townships are federally owned forest lands, but it also reflects environmental constraints such as soil and steepness of slopes. Of all the developments proposed to date, only The Pointe and Land and Leisure are located so they would drain naturally to Little Clear Creek and the Salt Creek Plant. Except for proposed developments clustered around the north side of the causeway, most are separated from one another by significant distances of open land which is wooded, with rugged terrain, steep slope, and numerous lake inlets.

Most of the Lake Monroe perimeter within Salt Creek and Polk Creek Townships is surrounded by U.S. Forest Service lands, part of the Hoosier National Forest. These forest lands surround every potential development around Lake Monroe except for The Pointe, Land and Leisure, Seven Flags and Brendon Shores. The U.S. Forest Service has taken a stance that it will not allow sewer line easements across its lands without the protection afforded by an areawide plan for the entire lake, presumably addressing the impact of such development.

1.3.7.8 Existing Seasonal Development/The Pointe

The Pointe, a condominium apartment development, is the sole major seasonal development being constructed around Lake Monroe. The first village, one of seven planned, was partially completed in August 1975, with 96 of the 200 planned units under roof. Each of the seven villages is planned to have a pool and tennis courts as its focus and draw. Each will contain approximately 200 units. Central recreation features now include a championship golf course. Joint arrangements have been made with Four Winds for use of their marina. Plans include a central sports complex centered around golf and tennis pro shops and restaurant facilities.

Current purchasers reside mainly in Indianapolis and Terre Haute, using their units for second homes. They are predominately professional's in their 40's and 50's.[13] The latter may be more of a reflection on the mix of units built in this first section which was predominantly three bedroom apartments.

Of the 96 units under roof (August 1975), some 45% reportedly have been sold.[13] This represents approximately a one year construction and marketing effort with respect to the residential aspects of the project. At this rate The Pointe may not meet its expected 1985 completion date. In fact, at this rate the completion might extend considerably beyond 1985. Certainly the overall market for housing is a little soft at this time, although this seasonal housing market consists mainly of affluent families, better capable of improving their relative position in a period of economic uncertainty. Units in this development range in price from $25,000 to $85,000 with most units probably priced in the $45,000 range. A sizable front end investment has been made in this project, such as an 18 hole golf course, roads, water, sewage treatment plant, etc., which would lead one to believe that it will be completed, and become a guaranteed part of future sewage flows within this area.

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[13] Conversation with Ron Jarrett, The Pointe.

1.3.7.9 LMRWD 201 Plan Projections

According to the LMRWD 201 Plan, seasonal flow projections for the major developments proposed at one time or another around Lake Monroe could total approximately 6400 units with an estimated flow of over 1.5 MGD by 1998, assuming a regional collection and sewer system.

The LMRWD consultant queried each potential developer to determine his projected 1998 sewage flows and their startup and completion schedules. Only three developers responded with schedules. Land and Leisure and Brendon Shores indicated a 1974 startup, while Graves and Moore indicated they were awaiting the public sewer system. Construction activity was apparent only at The Pointe during an August 1975 flight over the lake.

In Table 1-17, the Consultant has rearranged the projected LMRWD 201 Plan flow data by geographical location around the lake and grouped together developments that are relatively geographically contiguous.

Those seasonal developments reasonably close to the Salt Creek site and the interim facility on Little Clear Creek include The Pointe, Land and Leisure, Fairfax State Park and the Four Winds Marina. Flow projections for Fairfax State Park includes the Four Winds. This grouping of developments, etc., represents the area with the greatest potential for completion as well as for sharing sewerage services. The seasonal development within these two developments represents one-half of the proposed year 2000 sewage flows for the north and west side of the lake. This service area could also handle about one-half of that projected flow increase expected to be contributed by regional recreational facilities.

The Inland Steel project now lies dormant and the remaining second home projections on the north side of the lake have a potential waste load of .23 MGD, not including the Paynetown State Park. About 5 to 9 miles of open land separates this area from Fairfax, depending on whether or not Moores Creek Inlet is to be crossed by a sewer line. This particular area is located closer to Winston Thomas than it is to the Salt Creek site. Due to the lack of definite plans and schedules for development the feasibility for servicing this area is uncertain.

Considerably less seasonal development has been proposed for the south side of the lake. The largest of these proposals, Seven Flags, lies practically on top of the Salt Creek site. Seven Flags, Brendon

Shores and Chapel Hill proposed developments together account for one-half of the projected seasonal development sewage flow on the south side of the lake. Each is located close enough to the lake drainage divide to enable them to discharge effluent outside the Lake Monroe drainage district without worrying about discharges into the lake.

Developments on the southern side share with those on the northern side a lack of definite timetable and a wide distance separating each development from its so called neighbor.

Another factor complicating regional service is that national forest lands surround most of these developments and any joint collection system would require right-of-way easements through these Federal lands. This does not appear to be an immediate certainty, since the Forest Service has stipulated as a precondition to granting such easements that a coordinated areawide planning for the lake be developed. The latter may result as an outgrowth of the Lake Monroe Land Capability Study, but is probably some years away from becoming a reality.

1.3.8 The Seasonal and Second Home Market

Little regional analysis is available either from a governmental or an institutional sources that would enable the determination of the aggregate market for resort, seasonal and second homes within the Lake Monroe area.[14] At present there are some 6400 units or lots which have been conceived and planned. Some of these plans have already been cancelled[15], while others cannot offer much in the way of providing start-up dates, scheduling, etc.[16] At present there is no definitive answer as to whether any of these units will ever be constructed.

The prospect of a regional plan being developed as a result of the Lake Monroe Land Capability Study now underway may be a limiting factor to large scale seasonal development around the lake. Such a plan may limit or constrain lakeside development for environmental reasons, and possibly increase the cost of construction. The U.S. Forest Service's reluctance to allow easements across their land, without an overall land use plan for the lake should be considered another important constraint. In addition, the Indiana Department of Health discharge requirements will add to the list of limiting factors.

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[14] Dr. Morton Marcus, Indiana University, Bureau of Research and Planning, Graduate School of Business.

[15] Inland Steel Project, for example.

[16] Beam, Longest and Neff, Survey of Lake Monroe Developers.

Lacking areawide data, this Consultant investigated some national and regional literature on the second home market which isolated various usage and ownership characteristics. Several reports indicate that the second home market consists primarily of affluent metropolitan residents (two-thirds of all owners nationally), and most of these homes were located within a 100 mile radius of their year round residence.[17,18] The Indianapolis and Terre Haute SMSA's would, therefore, make up the primary market areas for Lake Monroe seasonal housing, being the most accessible to Lake Monroe, within a one and one-half hour commuting time. However, a 100 mile radius from Lake Monroe includes all of Indiana's Standard Metropolitan Areas except for the Gary-Hammond-East Chicago, South Bend and Fort Wayne. In fact, even the Cincinnati and Louisville SMSA's falls within this radius.

Nationally, the second home boom accelerated between 1950 and 1970, directly correlated with the viability of the economy and rising affluence of families in metropolitan areas. In that period, one-half of all the total second homes units were constructed.

Nationally second home owners consist mainly of small families, one or two persons, with one-third of all families having three to four members. About one-fifth of all seasonal homeowners nationally are over 65 years of age.[17]

Second home usage will also vary with the local climates, and whether the location is suitable for "four season" usage. Nationally, usage will range from 90 to 180 days. In 1967 second homes were mainly used almost exclusively by their owners with only ten percent of them rented.[17] In 1967 the average second homeowner reported a medium income nationally of $9600 - well beyond the overall national medium.

Experiences in the Pocono Mountain Region of Pennsylvania, an established four season vacation area serving the northeast megalopolis, indicates that less than one-fifth of all the seasonal lots existing at the time of the survey were built upon, and that land prices range from an average of $3,640 to $11,590 for lake-front locations.[19] Ninety percent of all lots were without community sewerage and fifty percent without public water. Electricity and roads seemed to be the major common improvements available. Retirees only comprised 10% of the buyers, and the median family income of Pocono land buyers was $16,098.

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[17] Housing Report, Series 121, U.S. Bureau of Census and the U.S. Forest Service, U.S. Government Printing Office, 1969.

[18] Supply Characteristics of the vacation home in Pocono Mountain Region, Center for Business Economics and Urban Studies, Lehigh University, Bethlehem, Pennsylvania, update.

[19] Housing Report, Series 121, U.S. Bureau of Census and the U.S. Forest Service, U.S. Government Printing Office, 1969.

Usually, the major attraction for seasonal and second homes is a body of water, and Lake Monroe is the largest man-made lake in the state of Indiana. Counterbalancing this attraction is the fact at Lake Monroe access cannot be purchased but is owned by the Corps of Engineers, which may discourage boating and swimming enthusiasts.

While the economy is a big factor in second home purchase, there are some positive factors in the second home market. The November 1974 House and Home Magazine, a housing trade publication, attributed the resort market's apparent survival of environmental pressures, gas shortage (at that time), runaway inflation, etc., to the fact that this market consists mainly of the affluent who have a greater discretionary income either less affected by inflation; or afraid that with inflation, their buying power will not be increased in the future. Many are buying as an investment and thinking about retirement. The projects that are in best shape are those that have the best combination of design and planning and the most attractive environment. The latter includes recreation attractions and facilities and thoughtful unit design.

Other factors that might stimulate this market include an innovative real estate concept called time-sharing, now emerging in Florida and California. Under time-sharing, a buyer actually buys a time frame for occupying the unit which is centrally managed for all buyers. Another more conventional method to reduce the investment needed or help defray owners costs is to sublease the second home. Buyers of units at The Pointe can take this course of action, although some developments prohibit subleasing.

1.4 SYSTEMS/COORDINATION AND COMPATIBILITY WITH PROJECTED LAND USE PATTERNS

1.4.1 Summary

Within this subtask, attention has been given to comparing and evaluating the relative differences between each plant site system with respect as to how well they relate to locally desired long range development goals, plans, and land use compatibility.

With respect to serving the near term urban area growth of the Bloomington area, the Winston Thomas site appears to be the best of all four choices; but from a long term viewpoint, the advantage falls to the Dillman site which was presumably selected as an optimal location to receive gravity flow from the two drainage districts flanking the urban area that are considered to be the long range growth areas. The Ketcham Road site also appears favorably with respect to the latter consideration. In fact, at first glance the Ketcham site is even better located since it could also collect gravity flows from the western drainage district. However, providing sewer service to the Western district with the resulting large interceptor would conflict with the Bloomington Use Plan which attempts to discourage intensive development on the environmentally sensitive lands within a large portion of this district. The Long Range Water and Sewer Plan also did not schedule the western interceptor. This apparent locational advantage of the Ketcham site is not really an asset in the time-frame under consideration.

The Ketcham and Salt Creek sites, particularly the latter, would be the more disruptive to the desired land use pattern for the urban region systems. Both would foster leap-frogging and sprawling type of development pattern on cheaper lands accessible to the interceptor sewer line. One Bloomington Land Use Plan goal is to foster the centralizing future development in higher density patterns to take advantage of the existing community infrastructure. Leap-frogging would tend to dissipate this effort by helping in dissipating the central area growth potential. This same leap-frogging and sprawling development pattern would have play havoc on those lightly populated rural areas that are little prepared to cope with the associated problems and costs.

In a total economic sense, uncontrolled development is the worst choice for both the public and the private economic sectors and both must pay for the extra costs that result. Granted, the control of sprawl is a difficult matter, but strong utility policies could play a most important role in this effort. The land use goal of higher density in more centralized locational patterns where the community framework develops gradually outward from the existing network is also a most economical pattern with respect to utility system development. A side benefit is that less pressure is put on less suitable vacant lands by speculative interests.

The list of total economic costs is long, involving both operating and capital expenses, and public and private interests. These are well documented in "The Costs of Sprawl," prepared in 1974 for the Council of Environmental Quality by the Real Estate Research Corporation. This same publication also documents the overall environmental effects as well as personal effects of sprawl in the community and the residents.

In terms of plant site location and compatibility with proposed land use and zoning patterns, the Salt Creek site is in obvious conflict with the existing zoning ordinance. The site is zoned for residential use as are its environs. Most of this site, which lies on a floodway, is not suitable for residential usage without the added expenses of flood protection and/or flood proofing. Existing document search did not clarify whether the South Rogers site was zoned or not, but the Land Use Plan indicated a residential usage pattern here. The other sites and their immediate environs are for the most part zoned for non-residential usage which would not conflict with a plant being located at those sites.

With respect to existing development patterns, Winston Thomas and South Rogers Site are the only two sites that have already been encroached upon by residential development. The Rogers Site is in fact occupied by a rather large mobile home park. It is difficult to assess just how critical the land use conflicts are at the Winston Thomas Site, since it was built and in operation long before the adjoining residential development occurred.

One very serious shortcoming complicating the entire land use issue is the lack of long range guidelines for development around Lake Monroe. The county zoning pattern appears to have placed part of the lake on hold, i.e., requiring extremely large residential lots in both Polk and Salt Creek townships as well as some other areas; although allowing unlimited residential development in Clear Creek and Perry townships. This same map, except for a few commercial zones, bears little relationship to the multitude of development proposals offered the lake. The analysis made possible with the present time constraint, unfortunately, has probably raised more questions than were answered. More importantly, the lack of planning around the lake puts the Consultant in the hazardous position of interfering in local land use decisions. This could result from the acceptance of a particular sewerage plan solution, which will by fiat establish a land use plan whether the municipalities desire that particular plan or not. The development of an overall totally coordinative land use and sewerage plan for the lake should be a priority item in Monroe County.

1.4.2 Coordination with City Land Use Plans

The City of Bloomington is responsible for charting the future growth and development of the urban area of Monroe County, while the county exercises that responsibility in the other areas which includes Lake Monroe.

The Bloomington Land Use Plan, circa 1970, maps land use patterns desired within the city's jurisdictional area, along with highway and utility plan improvements. The City Planning Commission's staff is of the opinion that this plan is a conceptually correct and acceptable portrayal of how the area might ultimately develop.[20] The city's Land Use Plan recognizes most of the recommendations of the Long Range Water and Sewer Plan such as the southwest, southeast, northeast, and northwest interceptors. The Long Range Water and Sewer Plan recommendation for the western interceptor was largely ignored, reflecting the land use goal to preserve rather than develop the environmentally sensitive western area. The plan shows the proposed treatment plant site location at Dillman Road.

The Bloomington Land Use Plan might be considered an optimum plan. It does not provide specific guidance in terms of the desired phasing of growth and development, such as when and where it would be most desirable to encourage growth and development. The Bloomington City

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[20] August 1975 conversation with Tom Crossman, Executive Director, and his assistant, Stuart Rueller.

Planning Commission Staff was able, however, to supply some direction in this regard. The answer to this question will depend largely upon the staging of the construction of the various proposed interceptor sewers.

The City Staff is of the opinion that physical growth constraints are more limiting to the west and northwest of the city than in any other directions. These mainly result from the unique Karst geological formation with its associated problems such as the development of sinkholes, solution cavities, and easy linkage to the groundwater supply. Other limiting factors in this sector, particularly for residential development include large areas now quarried and large industrial tracts located west of the city. In addition, State Route 37 Bypass and the railroads have cut this sector into smaller areas reducing residential appeal.

To the north of the city, the floodplain areas and rugged steep hillsides, are the major physical limitations. In addition, much of the remaining usable land is largely tied up in municipal watershed or university ownership. The rugged wooded topography which adjoins Lake Monroe extends westward toward the city to form a physical barrier to eastward expansion of the city. The more physically suitable and readily developable areas lie to the south and southeast of the city; the historic direction for residential growth. This potential urban growth area to the south extends down to Dillman Road which is fairly close to the Lake Monroe District Service Area. Within this latter service area, the nature of the terrain quickly changes to that of rugged wooded hills.

1.4.3 Coordination with County Land Use Plans

Monroe County does not have a long range planning guideline document available from which to make similar comparisons as in the city's jurisdictional area.[21]

1.4.4 Plant Site and Environs/Land Use Compatibility (See Plate 1)

1.4.4.1 Winston Thomas/Rogers Site

This plant site and immediate environs are in predominantly non-residential land usage pattern, except for the south portion of the Rogers Site which is now occupied by an 80 unit trailer park. While Old State Route 37 to the east of the site has developed commercially, residential development has occurred across the creek and railroad right-of-way west of the Winston Thomas Plant, the plant site construction preceded this residential development. The latest addition to this residential fabric is a new middle school opening this year at the corner of Rogers Road and Gordon Pike. Much of the view toward the Winston Thomas site from the higher residential development is partially screened on the western side of the plant by the creek and railroad tree lines. Much of the existing plant site lies within the floodplain of Clear Creek.

---

[21] Conversation with Mr. Lee Hardy, August 1975.

The Bloomington Land Use Plan for the Winston Thomas site reflects its non-residential potential, while the Rogers Site and most peripheral areas are considered suitable for low density residential development, except east of Old State Route 37 where commercial development is contemplated. The site is zoned for special conservation and light manufacturing with a low density residential zone on the northern periphery. The east side of Old State Route 37 is zoned for arterial business. Either the city's zoning jurisdiction ends at Gordon Road, or the Zoning Map is incomplete, because zoning district lines were not indicated south of Gordon Road.

The special conservation district is designed to protect lands with high water tables or flooding, and most of the treatment plant site lies within this zone. The city has adopted floodway and fringe area regulations for the 100 year flood contour. Permitted uses within this floodway mainly include agricultural and recreational activities having a non-structural character that would tend not to obstruct, confine, or impede flood flows.

1.4.4.2 The Dillman Site

The Dillman Site is located between two railroad rights-of-way paralleling Clear Creek. Most of the land is now vacant. State Route 37 cuts the site into two pieces. The general land use character of the environs is rolling pasture land and fallow bottomland with homes located up on the hillside to the west of the site along Victor Pike. This site has little potential other than for an open and agricultural usage, and is not well suited for residential development.

The Dillman Site is located at the extreme southern edge of the optimum plan area. An analogy has been made that the Dillman Site is now located with respect to urban growth as was the Winston Thomas Site some years back. This observation ignores the fact that the area available for expansion increase is directly proportional to the square of the radius as development radiates outward. Furthermore, it is unlikely at the present rate of growth that the Dillman Site would be surrounded by residential development, even if the zoning allowed residential development.

Both the Bloomington Plan and the County Zoning Ordinance consider this area to be more suitable for non-residential usage. The Bloomington Plan shows most of the site in a special conservation floodplain district with commercial development at the northeast corner of Dillman Road and State Route 37. The Bloomington Land Use Plan does not portray residential development below Clear Creek. The Dillman site, as well as the Ketcham Road Site, is located within a huge proposed industrial zoning district, some 5-1/2 square miles in area. Except for a few level upland areas, most of this industrially zoned land has little suitability for industrial usage, except possibly for quarrying, etc., a predominant existing industrial activity.

1.4.4.3 Ketcham Site

The Ketcham Site, like Dillman, consists of bottomland located between the two railroad rights-of-way. The general environs of the Ketcham Site is even more rural than at Dillman. Land use is typified by occasional small farms, fallow lands, rural housing, and what appears to be an abandoned quarry. A plant located here should not interfere with any current land use activities.

1.4.4.4 Salt Creek Site

The Salt Creek Site consists mainly of a wide bottom which is now farmed at the confluence of the Clear and Salt Creeks. The main value of this land is for agricultural purposes, however, the soils here appeared to be poorly drained and tile fields have been installed to dewater the site area for farming. The only possible land use in compatibility might be with a proposed seasonal development that could be located up the hill from the proposed site. The site area is now zoned residentially.

TABLE 1-1

FLOW COMPARISONS (MGD) YEAR 2000

	Consultant (Gilbert Associates, Inc.)	Bloomington LMRWD 201 Plans	Differences
Existing Flow*	11.2	11.2	-
Increase			
Residential	1.9	2.5	+.6
Industrial	0.4	1.0	+.6
University	-	0.2	+.2
Commercial	1.0	0.8	-.2
Subtotal Bloomington Region	14.5	15.7	+1.2
Lake Monroe Regional Waste District			
Year Round	.45(1)		
Seasonal	.55(2)		
Subtotal Lake Monroe	1.00	3.0	+2.0
TOTAL	15.5	18.7	+3.2

SOURCE: Bloomington 201 Facility Plan, and independent analysis by Consultant (Gilbert Associates, Inc.)

*Neither includes 1.9 MGD flow currently pumped north to Blucher Poole Plant.

Notes: (1) Assumes 0.30 MGD from residences (Ref. Table 1-15) and 0.15 MGD from institutional and recreation areas (Ref. Table 1-16)

(2) Assumes flows only from "The Pointe" and "Land and Leisure" (Ref. Table 1-17)

TABLE 1-2

COMPARISON OF POPULATION PROJECTIONS (Not adjusted)

	1970	1980	1990	2000
Monroe County				
City Planning Commission*	84,850*	90,500*	95,500*	102,500*
Bloomington 201 Plan	84,850	105,000	122,000	138,000
City Jurisdictional Area				
City Planning Commission*	63,000	68,000	72,000	77,000
Remainder of County				
City Planning Commission*	21,850	22,500	24,000	25,500

*Average between high and low projections -
Sources: City Planning Commission; Bloomington 201 Plan.

TABLE 1-3

COMPARISON OF CITY PLANNING COMMISSION AND 201 PLAN POPULATION PROJECTIONS AND ALLOCATIONS

	1970	1980	1990	2000
Monroe County				
- City Planning Commission, Adjusted[a]	90,849	96,500	102,000	108,500
- Bloomington 201 Plan	85,000	105,000	123,000	138,000
City Jurisdictional Area[b]				
- City Planning Commission (Adjusted)	69,000	74,000	78,000	83,000
County Population North of Major Drainage Divide				
- City Planning Commission	22,570	23,530	24,000	24,600
- Bloomington 201 Plan[e]	20,000	28,500	37,000	44,000
County Population South[c] of Major Drainage Divide				
- City Planning Commission	68,290	72,970	78,000	83,900
- Bloomington 201 Plan[e]	63,000	74,000	83,000	90,000
Central Southwest and Southeast Drainage Areas[d]				
- Gilbert Associates, Inc.	47,410	52,540	58,500	65,440
- Adjusted[a]	53,410	58,540	64,500	71,440

Source: Unpublished Projections City Planning Dept., Gilbert Associates, Inc. Calculations of Distributions for North and South Drainage Area.

[a] Adjusted upward by 6,000 students, assumed to be city residents and reside in the southern drainage area.

[b] Includes city plus two mile perimeter, some areas of which fall outside natural drainage ways of southwest interceptors.

[c] Includes Lake Monroe and southern area of county.

[d] Includes only population within these two natural drainage areas.

[e] Does not include total county population.

TABLE 1-4

SOUTH DRAINAGE AREA 1970 POPULATION ESTIMATES RESTRUCTURED TO REFLECT POPULATION CONTRIBUTORY TO INTERCEPTORS

1970

Township	Bloomington 201 Plan South Drainage	Southwest & Southeast Interceptors*	Change
Benton	990	-	-990
Bloomington	23,410	23,410	-
Richland	2,300	-*	-2,300
Van Buren	6,600	1,135*	-5,465
Perry	24,550	22,864**	-1,686
Salt Creek	793	-	-793
Polk Creek	290	-	-290
Clear Creek	2,470	-	-2,470
Indian Creek	876	-	-876
Total	62,279	47,409	-14,870

* Gilbert Associates calculations; also does not include population now pumped into system.

** Excludes 800 persons of the population residing within the LMRWD (Districts Service Area).

TABLE 1-5

1970 CENSUS DISCREPANCIES

U.S. Census Persons enrolled in college*	22,708
Indiana University 1970 enrollment	30,368
Net difference	7,660
U.S. Census Population in group quarters*	12,434
Indiana University Estimate of student housing	18,000
Net difference	5,566
Net difference population enrolled	7,660
Net difference population in group quarter	5,566
Estimate of student commutation**	2,594

* Residents of Monroe County

** Est. of students living outside of Monroe County

Source: U.S. Bureau of Census, Bloomington 201 Plan.

TABLE 1-6

Estimated Enrollment	Increase	GPCD	Estimated Flow (MGD)
Bloomington 201 Plan	4,500	45	0.20
University Est.	1,980	45	0.09

TABLE 1-7

1970 MONROE COUNTY EMPLOYMENT & JOBS

	Employment[a]		Jobs[b]		
	County Residents	Employed in Monroe	Total	Held by Commuter[c]	Commuter As % of Total
Manufacturing	6,435	5,600	9,300	3,700	40.0
Non-Manufacturing	26,572	23,120	27,550	4,400	16.0
Total	33,007	28,720	36,850	8,100	22.0

[a] U.S. Census

[b] Indiana Employment Service

[c] From counties other than Monroe.

TABLE 1-8

PROJECTED TOTAL EMPLOYMENT[a]
ECONOMIC REGION NO. 10 (BLOOMINGTON)
BLOOMINGTON 201 PLAN

Projected Total Employment Change 1975-1990	8,000
Monroe County Share (90%)[a]	7,200
Bloomington 201 Plan Manufacturing Employment Est.	7,200
Employment Change 1975-2000[b]	14,000
Monroe County Share (90%)[a]	12,600
Ratio Mfg/Non-Mfg (25%)[c]	3,150
Percent in southern drainage district (83.3%)[d]	2,620
Increase in Manufacturing Flow	
Bloomington 201 Plan (MGD) (7,200 x 165 gpcd) =	1.18
Gilbert Associates (2,620 x 165 gpcd) =	0.43

---

[a] Based on Monroe County's share of 1960 to 1970 population growth, Bloomington 201 Plan

[b] Straight line extrapolation to the year 2000

[c] Indiana Employment Security Office 1970

[d] Estimated current ratio of industrial flow

Source: Richard L. Pfister, Indiana University School of Business; Gilbert Associates Extrapolations & Flow Recalculations.

TABLE 1-9

CURRENT MUNICIPAL POPULATION TRENDS
LAKE MONROE REGIONAL WASTE DISTRICT
1960 - 1970 - 1973 (EST)

Municipality	1960	1960-1970 Change Net	1960-1970 Change %	1970	1970-1973 Change Net	1970-1973 Change %	1973
Clear Creek Township	2,250	-224	-10.0	2,474	100	4.0	2,574
Perry Township	6,461[a]	2,071	32.1	8,532	b	5.3[c]	b
Polk Township	572	-278	-48.6	294	15	5.1	309
Salt Creek Township	837	- 39	- 4.7	798	37	4.6	835
	10,120	978	9.6	12,098			

[a] Total excludes city of Bloomington and Broadview (U).

[b] Not comparable with 1960 and 1970 figures.

[c] Includes the City of Bloomington and Broadview (U).

SOURCE: U.S. Bureau of Census

TABLE 1-10

HOUSEHOLD CHARACTERISTICS 1970
LAKE MONROE REGIONAL WASTE DISTRICT
SELECTED MONROE DISTRICT MUNICIPALITIES

	Population per Household	Households
Clear Creek Township	3.36	736
Perry Township *	2.73	8,772
Polk Township	3.09	95
Salt Creek Township	3.28	234

* Includes City of Bloomington and Broadview (U).

SOURCE: U.S. Census

TABLE 1-11

ESTIMATE 1970 POPULATION
LAKE MONROE AREA

Townships	LMRWD Units	LMRWD Pop.	DSA Units	DSA Pop.	TOTAL Units	TOTAL Pop.	% Total Municipal Population
Clear Creek	300	1,008[a]	213	716	513	1,724	70
Perry	75	205	446	1,218[c]	521	1,423	17[b]
Polk	50	155	-	-	50	155	50
Salt Creek	66	216	-	-	66	216	27
Total	491	1,584	659	1,934	1,150	3,518	29

[a] Includes 440 persons residing in Harrodsburg area.

[b] Percent of Township excluding city of Bloomington and Broadview.

[c] Includes about 328 persons living within gravity flow district of Dillman.

SOURCE: Gilbert Associates, Inc. - Quad Sheet (1965-1966) housing count updated to 1970 by 104.8 percent, except for Clear Creek where this method would have exceeded the 1970 housing count.

TABLE 1-12

EXISTING 1970 INSTITUTIONAL AND RECREATIONAL FLOW CAPACITIES

	MGD	Population Equivalent
Perry Township		
Sanders School	.01	-
Clear Creek Township		
Water Plant	.02	-
Fairfax State Park*	.05	770
U.S.C.E.**	.01	160
Smithville School	.02	-
Harrodsburg School	.01	-
Subtotal	.11	930
Salt Creek Township		
Residences	.02	-
Paynetown State Park	.05	770
Subtotal	.07	770
Polk Creek Township***		
Residences	.01	-
Hardin Ridge U.S.F.S.	.04	667
Boy Scout Camp	.01	405
Subtotal	.06	772
TOTAL	.21	

* Includes Four Winds Marina
** Discharges to Salt Creek
*** East Side of Lake Monroe

SOURCE: LMRWD 201 Plan.

TABLE 1-13

ESTIMATE OF EXISTING FLOWS
YEAR-ROUND RESIDENCES

	LMRWD	Harrodsburg	DSA	Outside And Other Locations	Total
Clear Creek Twp.					
Units	60	131	136[a]	173	500
Population	202	440	457	581	1,680
Flow (MGD)	.02	.04	.05	.06	.17
Perry Twp.					
Units	-	-	80[b]	193[c]	273
Population	-	-	218	527	745
Flow (MGD)	-	-	.02	.05	.07
Total					
Units	60	131	216	366	773
Population	202	440	675	1,108	2,425
Flow	.02	.04	.07	.11	.24

[a] Smithville

[b] Sanders

[c] Handy plus area that drains toward Dillman or Ketcham Sites.

SOURCE: Gilbert Associates, Inc., estimate only includes significant population concentrations. Polk and Salt Creek Townships were considered too sparsely settled to include.

Note: 1. LMRWD figures on this table do not include Harrodsburg.

2. DSA = District's Service Area (see Figure 1-1)

TABLE 1-14

PROJECTED YEAR-ROUND POPULATION LAKE MONROE AREA - YEAR 2000

	LMRWD		DSA		Total	
Township	A	B	A	B	A	B
Clear Creek	1176	1460	836	1038	2012	2498
Perry	240	298	1420	2060	1660	2358
Polk	180	224	-	-	180	224
Salt Creek	252	312	-	-	252	312
Total	1848	2294	2256	3098	4104	5392

SOURCE: Gilbert Associates, Inc.

A. Assumes city planning commission growth rate of 16.7%.

B. Assumes current 1970-73 trend rate of 45.0%.

TABLE 1-15

PROJECTED FLOWS - YEAR 2000 YEAR-ROUND RESIDENCES

	LMRWD[a]		DSA		Other		Total	
	A	B	A	B	A	B	A	B
Clear Creek								
Population	750	930	532	662	678	842	1960	2434
Flow (MGD)	.08	.09	.05	.07	.07	.08	.20	.24
Perry Township								
Population	-	-	254	316	608	764	862	1080
Flow (MGD)	-	-	.02	.03	.06	.08	.08	.11
Total								
Population	750	930	786	978	1286	1606	2822	3514
Flow (MGD)	.08	.09	.07	.10	.13	.16	.28	.35

[a] Including Harrodsburg.

SOURCE: Gilbert Associates, Inc.

A. Assumes city planning commission growth rate of 16.7%.

B. Assumes current 1970-73 trend rate of 45.0%.

TABLE 1-16

INSTITUTIONAL AND RECREATIONS PROJECTED FLOWS

		1998 Flows MGD	Net Increase 1970 - 1998
Perry			
Sanders - School		.01	-
Clear Creek			
Smithville School		.02	-
Harrodsburg School		.01	-
Filter Plant		.02	-
Fairfax State Park		.09	.04
U.S.C.E.		.01	-
	Subtotal	.15	.04
Salt Creek			
Residences		.02	-
Paynetown State Park		.09	.04
	Subtotal	.11	.04
Polk Creek			
Residences		.01	-
Hardin Ridge U.S.F.S.		.04	-
Boy Scout Camp		.01	-
	Subtotal	.06	-
	TOTAL	.33	.08

SOURCE: LMRWD 201 Plan, Beam, Longest and Neff.

TABLE 1-17

PROPOSED SEASONAL/SECOND HOME FLOWS 1998 (MAJOR DEVELOPMENTS ONLY)

	Est. of[a] Residential Units	Est. of[a] Population	Est. Flows MGD
North Side of Lake			
Clear Creek			
The Pointe (under construction)	1,440	2,880	.50
*Land and Leisure	560	1,020	.05
Subtotal	2,000	3,900	.55
Salt Creek			
Inland Steel[b]	1,300	2,600	.26
*Graves, Moore, etc.	740	1,650	.15
Holiday Hills	205	450	.08
Subtotal	2,245	4,700	.49
TOTAL NORTH SIDE	4,245	8,600	1.04
South Side of Lake			
Polk			
Tan Tara	625	1,250	.13
Allens Creek	480	960	.10
Chapel Hill	100	200	.02
Subtotal	1,005	2,410	.25
Clear Creek			
*Brendon Shores	450	900	.09
Seven Flags	700	1,400	.14
Subtotal	1,150	2,300	.23
TOTAL SOUTH SIDE	2,155	4,710	.48
GRAND TOTAL	6,400	13,310	1.52

[a] Estimated by the Consultant at 100 GPCD, and 50 GPCP for campsites.

[b] Project now inactive.

* Did not reply to LMRWD consultants query as to potential startup dates.

SOURCE: LMRWD 201 Plan, Gilbert Associates Estimate of Units and Population.

TABLE 1-18

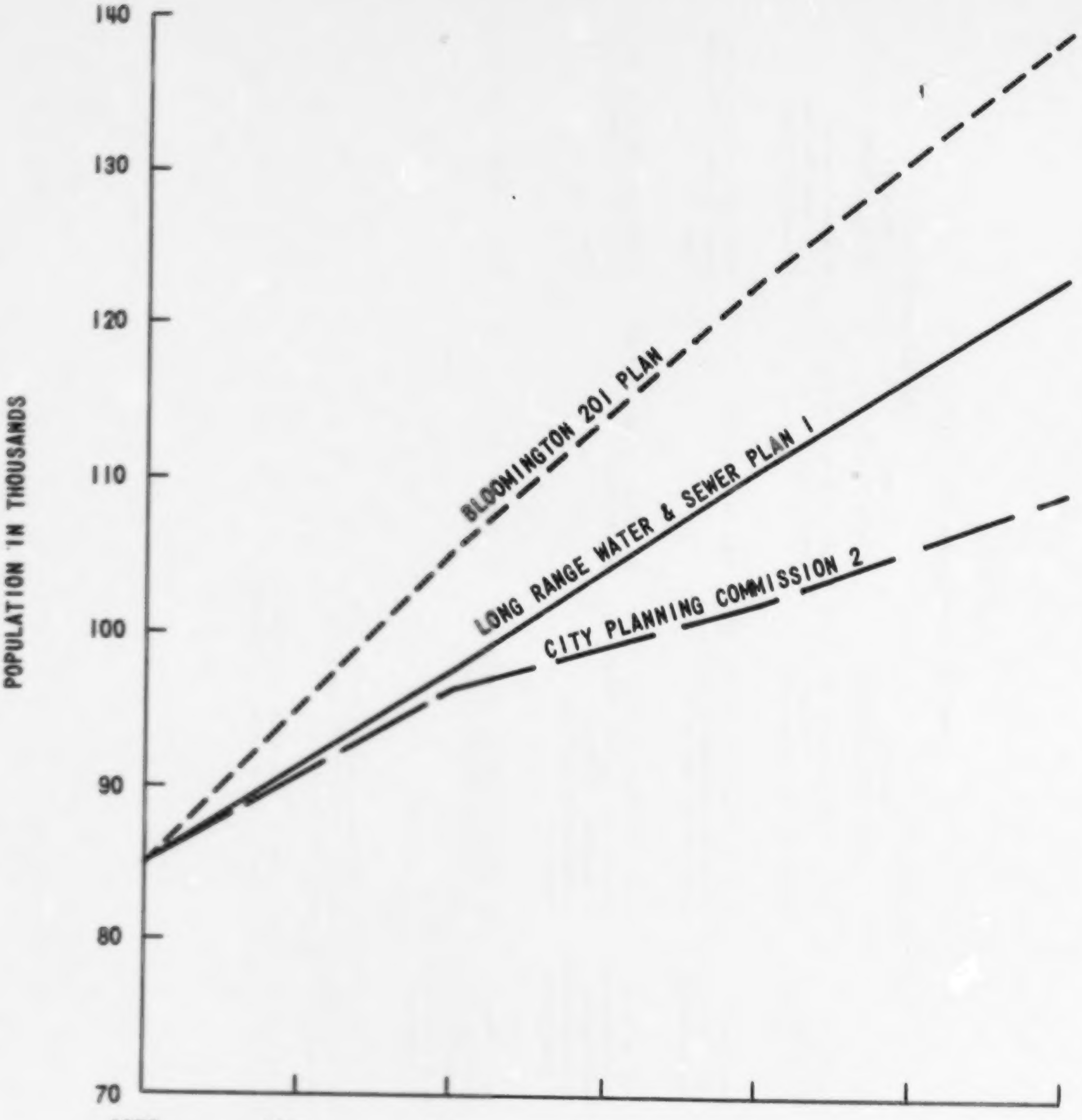
LAND USE COMPARISONS/ALTERNATE SITES

	LAND USE COORDINATION		LAND USE COMPATIBILITY		
SITE	GOALS	PROJECTED DEVELOPMENT PATTERNS	EXISTING LAND USAGE*	PROJECTED ZONING PATTERNS	TRAFFIC AND ACCESS
Winston Thomas	Excellent: Encourages centralization	Good: Major weakness too close in fit gravity configuration; seriously encroached upon.	Fair to Poor: Least compatible	Good to Excellent Site Zoned for Non-Residential Usage	Good
Dillman	Excellent: Encourages centralization	Good to Excellent: At edge of Projected development pattern; good gravity system fit.	Good to Excellent	Excellent: Entire area Zoned for Non-Residential Usage	Good to Excellent bridge needs replacing
Ketcham	Good to Fair: Would encourage leapfrogging, decentralization to some degree.	Good: Optional for full gravity fit, but may induce development in Western ecologically sensitive district	Excellent: Most isolated of all sites	Excellent: Entire area Zoned for Non-Residential Usage	Poor: Significant hazzards and barriers
Salt Creek	Poor: Would encourage decentralization more than other alternatives	Poor: With respect to serving Bloomington Jurisdictional Area	Good to Excellent	Poor: Zoned for residential	Good to Excellent Difficult grades

There is no land use plan for the Lake Monroe Area, although the area is zoned in a combination industrial, low density, residential, and forest reserve categories with some isolated commercial districts.

* NOTE - All alternatives located within floodways except the Salt Creek Plant --- Although most of the latter property is in the floodway.

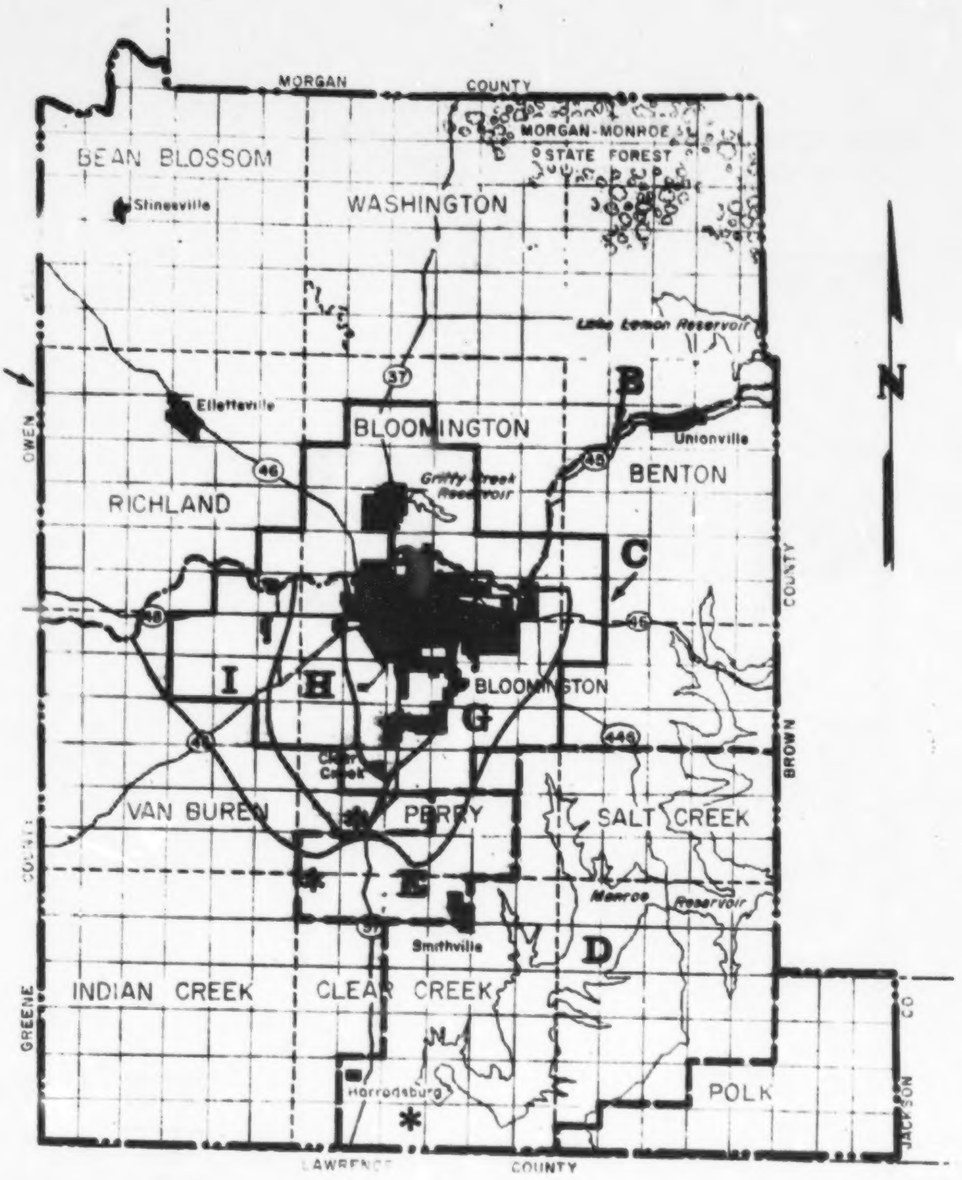
FIGURE - 1-1
A COMPARISON OF MONROE COUNTY POPULATION PROJECTIONS



1. STRAIGHT LINE EXTRAPOLATED BY GAI FROM 1990 TO 2000

2. MEAN AVERAGE POPULATION ADJUSTED UPWARD BY 6000 PERSONS FOR 1980, 1990 AND 2000 TO REFLECT 1970 UNDERREPORTING

FIGURE - 1-2
DRAINAGE JURISDICTIONAL BOUNDARIES

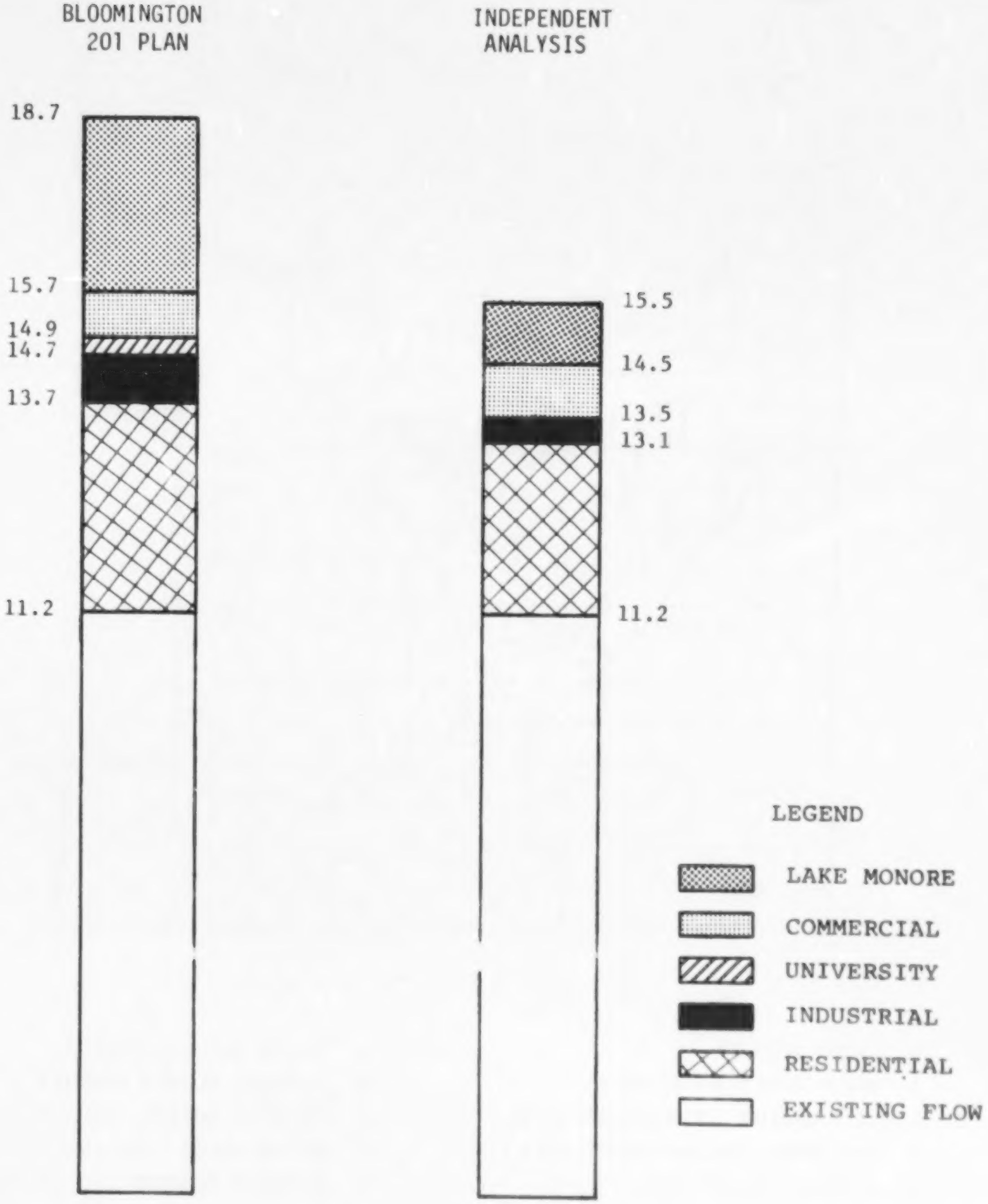

MORGAN COUNTY
MORGAN-MONROE STATE FOREST
BEAN BLOSSOM
Stinesville
WASHINGTON
Lake Lemon Reservoir
N
B
37
Ellettsville
BLOOMINGTON
Unionville
OWEN
46
45
RICHLAND
Griffy Creek Reservoir
BENTON
C
48
I
H
G
BLOOMINGTON
446
Clear Creek
VAN BUREN
PERRY
SALT CREEK
E
Monroe Reservoir
37
Smithville
D
INDIAN CREEK
CLEAR CREEK
GREENE
COUNTY
BROWN
COUNTY
Harrodsburg
POLK
JACKSON CO
LAWRENCE COUNTY

LEGEND

A. COUNTY BOUNDARY
B. NORTH-SOUTH DRAINAGE DIVIDE
C. CITY PLANNING JURISDICTIONAL AREAS
D. LAKE MONROE REGIONAL WASTE DISTRICT
E. DISTRICTS SERVICE AREA
F. CENTRAL DRAINAGE DISTRICT
G. SOUTHEAST DRAINAGE DISTRICT
H. SOUTHWEST DRAINAGE DISTRICT
I. WESTERN DRAINAGE DISTRICT
+ ALTERNATE TREATMENT SITE LOCATIONS

FIGURE 1-3

FLOW COMPARISONS - YEAR 2000
(MGD)



TASK 2

EVALUATION OF PURE OXYGEN PROCESS

The use of oxygen rather than air in the activated sludge process is an advancement that often offers higher quality treatment from existing plants and construction of new facilities at reduced cost. The pure oxygen process requires a covered oxygenation tank and high purity oxygen (90-100 percent volume). Because of higher DO levels, the biological solids settle faster resulting in reduced detention times. There is less wasted activated sludge and a higher BOD load at comparable effluent quality. A comparison of the unit processes for pure oxygen and conventional activated sludge is given in Figure 2-1.

A cost comparison was made utilizing the pure oxygen process and the complete mix activated sludge process utilizing air. The analysis included comparing both processes using Clear Creek and Salt Creek effluent standards.

According to Indiana State regulations, the following effluent standards will be required by 1977 for discharges to Salt Creek and Clear Creek.

	Salt Creek	Clear Creek
BOD (Biochemical Oxygen Demand)	10 mg/l or 95% removal	5 mg/l or 97.5% removal
Suspended Solids	10 mg/l or 95% removal	5 mg/l or 97.5% removal
Phosphorus	1 mg/l or 80% removal	1 mg/l or 80% removal
Ammonia Nitrogen	6.5 mg/l in summer no limitation in winter	1.5 mg/l summer 3.0 mg/l winter

The significant difference between a Salt Creek plant site and Clear Creek plant site is the nitrogen effluent standards. In order to obtain a NH_3-N (ammonia nitrogen level) of 1.5 mg/l, a two stage aeration process is recommended. A single stage nitrification process would be suitable to meet Salt Creek effluent requirements.

The single stage nitrification process achieves biological oxidation of carbonaceous and nitrogenous compounds in one aerated unit with a corresponding clarifier unit. The system is based on a single sludge culture of mixed organisms.

The two stage system consists of two essentially identical sets of activated sludge units with two sets of sedimentation units. Each activated sludge unit has its own separate sludge system. The first system oxidizes the carbonaceous matter (conventional activated sludge), the second oxidizes nitrogenous compounds (nitrification).

The cost analysis was based on the aeration and clarifier treatment units alone at a flow of 15 MGD. It was assumed that the pure oxygen process would produce a sludge of sufficient density that would eliminate the need for a thickener. It was assumed the air process would require a thickener. Operation and maintenance costs in the analysis only concerned the aeration units, clarifiers and thickeners.

Sizing of the pure oxygen process components (aeration, clarifier and power requirements) was done in consultation with manufacturers of equipment for the process. Significant design parameters concerning the pure oxygen are as follows:

	Single Stage (Salt Creek)	Two Stage (Clear Creek)
Detention Time (hrs.)	3	3(1.5 hours each)
MLSS (mg/l)	4,500	4,500
Recycle Flow (% of Q)	30	30
Clarifier Dia. (ft.)	115	115
Brake Power	594	626

The significant design parameters concerning the air process are as follows:

	Single Stage (Salt Creek)	Two Stage (Clear Creek)
Detention Time (hrs.)	6	8 (4 hrs. each)
MLSS (mg/l)	3,000	3,000
Recycle Flow (% of Q)	43	43
Clarifier Diameter (ft.)	100	100
Brake Horsepower	516	543

The above data indicates that it was assumed that aeration volumes did not vary as a result of the site being located on either Salt or Clear Creek, however, detention times significantly varied between the air (8 hours) and pure oxygen (3 hours). The power required to run the aeration systems at ultimate load

(15 MGD during the summer) did not vary significantly between plant sites or process. It should be noted that the pure oxygen process did require more power than the air process. There was a significant difference in equipment costs between the air and oxygen process. The equipment required for an air process was quoted at $390,000 while the pure oxygen equipment was quoted at $1,900,000.

Clarifier size was a process variable. Clarifiers were designed on a basis of 700 GPD/sq. ft. overflow rate and a solids loading of 25 lbs/sq. ft. The air process required clarifiers to be sized at 100 ft. in diameter. However, the pure oxygen process required clarifiers to be designed with a diameter of 115 feet. The increased diameter was required because of the higher solids concentration being carried in the pure oxygen process and therefore an increased solids loading to the clarifier over the air process.

As stated previously, the two stage process requires a second set of clarifiers because of the two separate sludge systems, whereas the single stage process only requires one set of clarifiers.

Power costs for pumping return activated sludge will favor the pure oxygen process as the percent return sludge is less with the pure oxygen process. The two stage process will require additional pumping costs in the form of both capital and operating as there are two sludge systems.

Construction costs for the aerations tank and equipment as well as the clarifier tank and equipment were calculated by obtaining manufacturers' quotes for the equipment and performing takeoffs for the concrete, excavation, etc., for the aeration and clarifier tanks. Power costs were determined by using 2¢/KWH.

Material and supply costs were determined by using "Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities." Construction, operation and maintenance costs for the thickener were determined from this source also.

Table 2-1 shows construction, project, operating and salvage costs. These costs have been put in terms of present worth. It is evident from the analysis that the complete mix activated sludge process utilizing air is more economical than the pure oxygen process for either the single stage or two stage system. A summary of the table follows:

Alternative	Present Worth
Single Stage - Air	3,498,000
Single Stage - Oxygen	5,510,000
Two Stage - Air	6,060,000
Two Stage - Oxygen	7,925,000

TABLE 2 - 1

COST OF PURE OXYGEN VERSUS AIR AT THE SALT CREEK* AND CLEAR CREEK SITES* @ 15 MGD

					Percent Worth				
Alternative	Construction Cost	O&M @ 11 MGD	O&M @ 15 MGD	Salvage Value	Project Cost	O&M	Salvage Value	Total	Rank
Single Stage - Air	1,975,000	101,000	138,000	1,297,000	2,568,000	1,327,000	397,000	3,498,000	N/A
Single Stage - Oxygen	3,320,000	119,000	161,000	1,152,000	4,316,000	1,546,000	352,000	5,510,000	N/A
Two Stage - Air	3,708,000	150,000	205,000	2,336,000	4,821,000	1,953,000	714,000	6,060,000	2
Two Stage - Oxygen	4,940,000	168,000	231,000	2,277,000	6,422,000	2,199,000	696,000	7,925,000	4
Thickener	210,000	20,000	28,000	146,000	274,000	267,000	44,000	497,000	N/A
Single Stage - Air and Thickener								3,995,000	1
Two Stage - Air and Thickener								6,557,000	3

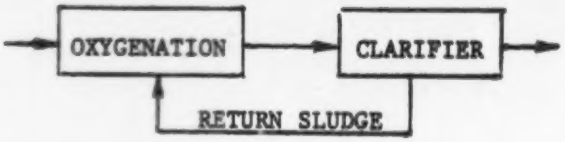
* At the Clear Creek sites a two stage process would be used.
Salt Creek required single stage.

FIGURE 2-1

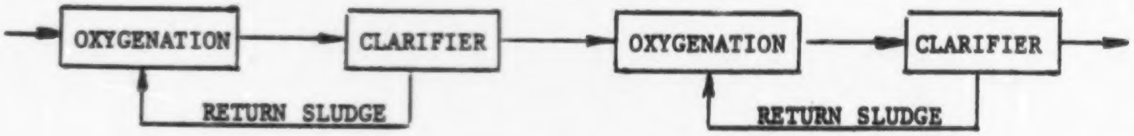
SYSTEM DIFFERENCES
PURE OXYGEN VS. CONVENTIONAL ACTIVATED SLUDGE

Pure Oxygen Activated Sludge

Salt Creek

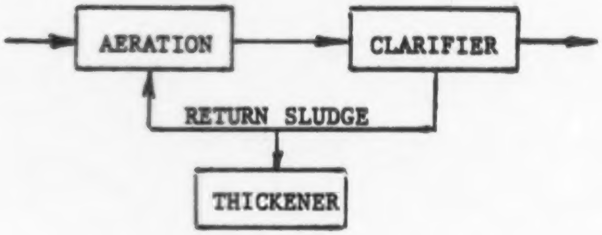

OXYGENATION
CLARIFIER
RETURN SLUDGE

Clear Creek

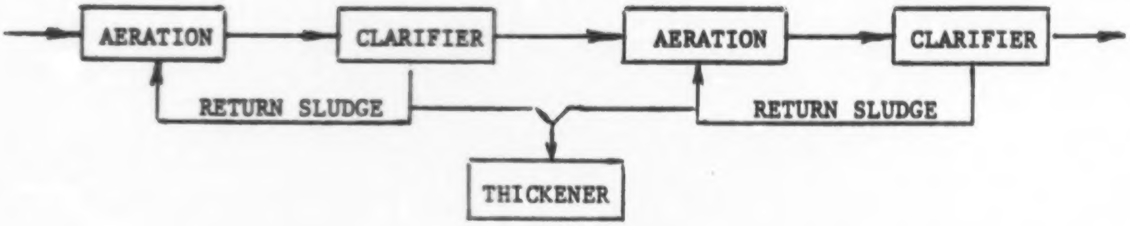

OXYGENATION
CLARIFIER
RETURN SLUDGE
OXYGENATION
CLARIFIER
RETURN SLUDGE

Conventional Activated Sludge

Salt Creek


AERATION
CLARIFIER
RETURN SLUDGE
THICKENER

Clear Creek


AERATION
CLARIFIER
AERATION
CLARIFIER
RETURN SLUDGE
RETURN SLUDGE
THICKENER

TASK 3

RENOVATION AND EXPANSION OF WINSTON THOMAS SEWAGE TREATMENT PLANT

The present plant is a secondary treatment plant with grit removal facilities, primary clarification, biofiltration, secondary clarifiers, chlorination and an oxidation pond. Sludge handling is accomplished by anaerobic digestion and drying beds.

Portions of the plant date back to 1934, with improvements and expanded facilities added in 1955 and 1969. The present plant has primary units capable of handling 7 MGD average daily flow and the secondary units have a capability of handling a 5 MGD average daily flow. The plant is currently processing average daily flow of 11.2 MGD.

A tour of the Winston Thomas plant was completed as part of the scope of work for this project. The inspection of the plant revealed a facility showing signs of its age; the units are 20 and 40 years old. The primary clarifier drive, sludge collector equipment and gear bores are badly worn. The concrete in the final clarifiers is structurally damaged. The biofiltration design is an outdated fixed nozzle design. The biofiltration units require considerable maintenance for cleaning and repairing nozzles since the nozzles are specially manufactured and must be constructed individually at the plant. There are also cracks in the concrete walls of the digester which have allowed sludge leakage.

It is the opinion of the Consultant that use of the existing Winston Thomas plant would be very inconvenient considering process, operating and maintenance problems. The treatment process required to meet the new effluent standards would not normally incorporate the biofiltration process. If the new plant were to use the biofiltration process and activated sludge process to meet the new effluent standards, it would require plant personnel to operate and maintain two entirely different processes. The previously mentioned differences concerning the equipment and structures of the existing treatment facilities would require considerable maintenance, repair and replacement dollars.

It is also the Consultant's opinion that the phased construction of new facilities along with the required demolition and renovation of existing facilities would require that the effluent standards (30 mg/1 BOD_5 and 30 mg/1 suspended solids) could not be met at all times.

Therefore, it is not recommended that the existing facilities be considered as a viable alternative for providing the required treatment plant facilities. However, there is sufficient land available for a 15 MGD plant on the Winston Thomas plant site, west of the existing facilities. If the plant were placed in the area, continuous operating of the existing facilities could be practiced while the new plant was constructed without any interruption or degradation of effluent quality. When the new plant was completed, flow to the old plant would simply be shut off and diverted to the new plant.

TASK 4

PLANT CAPACITIES

The population projections developed in Task 1 indicate that design capacities for the proposed plants should be somewhat less than those indicated in the 201 Facilities Plan.

Examination of present population densities and projected development patterns within the 20 year planning period indicates that a regional plant to serve both the Bloomington area and the Lake Monroe area is not feasible at this time. Instead, based on present population projections, it appears to be more realistic to build a separate plant to serve the Bloomington south drainage area and serve the Lake Monroe area with one or more smaller plants.

Based on the population projections, a plant capacity of 15 MGD will be required to serve the south Bloomington service area through 1995. This capacity would apply to the Winston Thomas, South Rogers Street, Dillman Road, and Ketcham Road sites. A total flow of 1 MGD is projected for the Lake Monroe Area.

The 15 MGD figure developed for the south Bloomington drainage area assumes the continuation of pumping of 1.9 MGD at the central lift station of sewage from the south drainage area to the north plant. The north plant is presently greatly underutilized and is expected to remain so for the foreseeable future. The low operation and maintenance costs for the pumping and force main indicate that this practice should be continued.

In evaluating the effects of inaccurate flow metering at the Winston Thomas plant, it appears that 11.2 MGD represents the present average daily flow to the plant.

The possibility of phased construction was considered for the new Bloomington south plant, but was rejected because of the relatively slow growth rate now projected for the Bloomington area. If the projected growth were slow for the first ten years of the design life and rapid for the last ten, staging of construction (building a new plant now, with an expansion later on) would be appropriate.

TASK 5

CLEAR CREEK TREATMENT PLANT TRADEOFFS EVALUATION

5.1 INTRODUCTION

In addition to the issue of regionalization (of the Bloomington and Lake Monroe areas), a number of other factors must be considered in the determination of the final treatment plant site location.

For the City of Bloomington, a treatment plant site on Salt Creek means the construction of a long outfall sewer (13.4 miles); but since effluent requirements are less stringent on Salt Creek, a less expensive plant can be built than would be required on Clear Creek. It is assumed, in this analysis, that the same treatment process train would be used for any of the alternative sites on Clear Creek.

5.2 TREATMENT REQUIREMENTS

The Clear Creek and Salt Creek effluent standards are as follows:

		Clear Creek	Salt Creek
BOD_5	(mg/l)	5	10
Suspended Solids	(mg/l)	5	10
Phosphorus	(mg/l)	1	1
Nitrogen	(mg/l)		
Summer		1.5	7.9
Winter		3.0	N/A

The significant difference between the Salt Creek and Clear Creek effluent standards is in the nitrogen standard. Nitrogen conversion is not required during the winter months, defined as 5 months of the year, if discharge is to Salt Creek. Nitrogen conversion is required year round if discharge is to Clear Creek. The degree of nitrogen conversion also varies depending on the point of discharge. During the summer months, an ammonia nitrogen discharge level of 1.5 mg/l is required at Clear Creek, while a level of 7.9 mg/l is mandated for Salt Creek. (Based on a 15 MGD flow)

Because the two stage nitrification system is capable of essentially complete nitrification at all times, and because incomplete nitrification is characteristic of winter performance of single stage systems, the two stage system was chosen for Clear Creek sites and the single stage system for the Salt Creek site.

The single stage nitrification process achieves biological oxidation of carbonaceous and nitrogenous compounds in one aerated unit with a corresponding clarifier unit. The system is based on a single sludge culture of mixed organisms. The two stage system consists of two essentially identical sets of activated sludge units with two sets of sedimentation units. Each activated sludge unit has its own separate sludge system. The first system oxidizes the carbonaceous matter (conventional activated sludge); the second oxidizes nitrogenous compounds (nitrification).

Concerning costs, a two stage system has both higher capital and operating cost. As discussed previously, the two stage system requires two sets of clarifiers with corresponding additional capital and operating costs. Also, because a two stage system has two separate sludge systems, return sludge pumping costs are twice those of a single sludge system. Additional construction costs are necessary for additional piping, pumps and pump structures. Because there are more facilities to operate in a two stage system as opposed to a single stage system, more manpower will be required to operate a two stage system. Power costs for the single stage system are less than the two stage system by the nature of the effluent requirements, since no ammonia conversion is required during nine months of the year.

Concerning process reliability, a two stage system affords protection of nitrifying organisms from sludge loads of toxic materials, high organic loads and peak flows. It is important to realize that the nitrifying organisms are unique and that the mixed liquor suspended solids must not be allowed to escape from the system. A two stage system by its very nature affords better protection of the organisms and can provide a better flexibility for growing the organisms as well as phosphorus removal. Both systems can readily be followed by clarification units.

In summary, it is the Consultant's opinion that a single stage nitrification is appropriate for Salt Creek effluent standards and a two stage system is appropriate for Clear Creek effluent limitation. The following is a tabular presentation of the trade offs between the two systems.

	Clear Creek (Two Stage)	Salt Creek (Single Stage)
Construction Cost	$3,320,000	$1,975,000
O & M @ 15 MGD	$ 205,000	$ 138,000
Present Worth	$6,060,000	$3,498,000
Man power (hours) (annual)	7,500	5,500

5.3 OTHER FACTORS

Table 5-1 lists a number of additional factors considered in the comparison of the Salt Creek and Clear Creek plant sites. In terms of the cost required to meet effluent requirements, the Salt Creek site has a definite advantage. However, in terms of the quality of the discharge, a Clear Creek plant would produce a superior effluent because of the higher degree of treatment required. Furthermore, the two stage process which would be utilized at the Clear Creek site would be more reliable in terms of maintaining a consistently high effluent quality than the single stage process which would be employed at the Salt Creek site.

A water supply intake for the City of Bedford, Indiana is located on Salt Creek approximately 13 miles downstream from the confluence of Clear Creek and Salt Creek. If the Bloomington south treatment plant were located at any of the Clear Creek sites, the added travel distance in Clear Creek would provide more instream aeration of the discharge before it reached the Bedford intake, than if the plant were on Salt Creek. However, in terms of immediate dilution in the receiving stream, the Salt Creek site would be favored because of the higher flow in Salt Creek.

The high cost of the long outfall sewer necessary for the Salt Creek site, plus the probability of adverse environmental effects resulting from the construction of the outfall definitely favor a Clear Creek site. However, more land is available at Salt Creek for plant construction and future expansion. In addition, large areas of bottom land suitable for sludge disposal are located closer to Salt Creek than the Clear Creek site.

In terms of plant operating costs and energy costs, the Salt Creek site is favored because it would be a single stage process as opposed to a two stage process at any of the Clear Creek sites.

A final point favoring the construction of the plant at a Clear Creek site is the fact that by not discharging the effluent to Clear Creek, the flow in the creek could at times be reduced to zero.

TABLE 5-1

COMPARISON OF SALT CREEK AND CLEAR CREEK SITES

	Factor	Favor Clear Creek Sites	Favor Salt Creek Site
1.	Effluent requirements (cost to attain)		X
2.	Effluent requirements (water quality)	X	
3.	Distance from discharge to Bedford water supply intake	X	
4.	Cost for outfall sewer from Bloomington	X	
5.	Environmental effects of outfall sewer	X	
6.	Land area available		X
7.	Plant operating costs		X
8.	Effluent dilution in receiving stream		X
9.	Effect on low flow in Clear Creek	X	
10.	Reliability of process to maintain effluent quality	X	
11.	Energy requirements		X
12.	Proximity to land suitable for sludge disposal		X

TASK 6

PRESENT WORTH ANALYSIS

6.1 PLANT SITE AND INTERCEPTOR ALTERNATIVES

Alternative treatment plant site locations are shown on Plate 1. All locations have sufficient land area available to permit future expansion of the presently proposed 15 MGD plant to 30 MGD.

All pipe sizes and lengths for interceptors are the same as shown in the 1974 201 Facilities Plan and the 1975 amendment. Sizes and lengths of various interceptor sections are shown in the calculations in the Appendix F of this report.

6.1.1 Alternative 1

The treatment site for this alternative would be located at the confluence of Clear Creek and Salt Creek. The site offers 320 acres of land. Approximately 60 acres of this would be sufficient for the plant's needs. Flood protection and 1000 feet of stream relocation are necessary at the Salt Creek site. The present worth analysis does include a separate item for additional land (320 - 60 = 260 acres) available at Salt Creek.

Sewage would be transported by an interceptor that would flow entirely by gravity from the existing Winston Thomas plant site along Clear Creek to the Salt Creek plant site. The total length of pipe would be 71,000 feet. The proposed routing would also require 25 concrete-encased stream crossings and 15 railroad borings. A minimal expenditure in maintenance would be necessary for the interceptor.

6.1.2 Alternative 2

This scheme would also use the Salt Creek treatment plant site discussed under Alternative 1. The interceptor would flow by gravity from the Winston Thomas plant site along Clear Creek to a pump station near Jackson Creek. A force main would carry sewage along the Monon Railroad to Smithville where it would discharge into a gravity sewer. This sewer could be constructed in the abandoned railroad right-of-way, then flow along Little Clear Creek to the Salt Creek site. The total length of the interceptor would be 57,500 feet. A significant reduction in stream and railroad crossings could be realized by using this alternative rather than Alternative 1. However, the savings would be partially offset by the cost of the pump station. The pump station would have a peak capacity of 40 MGD and a total dynamic head (TDH) of 140 feet.

6.1.3 Alternative 3

This alternative would utilize a treatment plant located on Clear Creek at its intersection with Ketcham Road. The Ketcham Road site offers approximately 60 acres of land for a plant site. Clear Creek makes a circuitous path through the existing site and it is presently subject to flooding. Therefore, 2,500 feet of stream relocation would be required with dikes for flood protection.

The transport system would be a gravity interceptor from the Winston Thomas plant site along Clear Creek to the Ketcham Road site. The total length of this interceptor would be 23,400 feet.

6.1.4 Alternative 4

This alternative is similar to Alternative 3. The treatment plant would be located on Clear Creek immediately upstream from its intersection with Dillman Road. The Dillman Road site has available 60 acres of land. Clear Creek meanders through the site. In order to construct a treatment plant at the site, 2,000 feet of stream would have to be relocated along with flood protection.

The interceptor would follow the same route along Clear Creek as Alternative 3, but would terminate at the Dillman Road site. Alternative 4 would require 12,600 feet of interceptor sewer pipe, the least of any of the alternatives considered.

6.1.5 Alternative 5

Under this alternative, sewage would be pumped from the southwest and southeast interceptors upstream along Clear Creek to the South Rogers Street Site. Two pump stations would be required, one to pump the flow from the southwest interceptor and the other to pump the flow from the southeast interceptor. The southwest pump station was sized on an average daily flow of 3.5 MGD and a TDH of 52 feet. The southeast pump station was sized on an average daily flow of 6.5 MGD and a TDH of 71 feet. The total length of the force main would be 15,000 feet.

The South Rogers Street Site presents a unique problem. There is an existing mobile home development on the site which would have to be relocated. An assumed cost of $500,000 has been included in site development costs for the South Rogers Street Site to purchase the mobile home development and relocate the existing homes. The South Rogers Street Site is comprised of approximately 40 acres which will require approximately 4,500 feet of stream relocation and flood protection.

A separate evaluation of transmission of sewage to the Winston Thomas plant was not undertaken. However, its proximity to the South Rogers Street Site suggests that the cost for transporting sewage to either of them would be approximately equal.

Sufficient land is available to the west of the existing Winston Thomas treatment facilities to provide for a complete 15 or 16 MGD plant. In order to accomplish this, a stream relocation of approximately 3,200 feet would be necessary. Flood protection would also be required. It is assumed that the land is owned by the City of Bloomington.

A basic uncertainty in the costing of this alternative is the timing of construction of the southeast and southwest interceptors. Without these interceptors, the force main and pumping stations would not be needed to transport sewage upstream along Clear Creek to the plant site. In the basic analysis for this alternative, it has been assumed that the southeast and southwest interceptors would be constructed in 1985 (year 10). The location of the proposed interceptors is shown on Plate 2. The assumption of construction in 1985 is based upon this consultant's best estimate of when population will grow to a sufficient level in the southwest and southeast drainage areas to warrant construction of the interceptors. However, because of the degree of uncertainty in the timing of these interceptors, alternative estimates have been made for Alternative 5. Alternative 5A assumes that the southeast and southwest interceptors will be built in 1990, while Alternative 5B assumes that they will not be built until after the year 2000.

6.2 EXPLANATION OF PRESENT WORTH ANALYSIS FOR INTERCEPTORS

A summary of design criteria for the interceptor alternatives is found in Table 6-2.

A number of assumptions were made in the compilation of the cost table. Capital costs, obtained from unit price take-offs (see Table 6-3) are converted to project costs by multiplying by a factor of 1.3. This factor includes allowances for engineering and legal fees, contingencies, right-of-way costs, etc.

Operation and maintenance costs for the gravity systems are very small. One or two man-days per month would be required to maintain the lines. The O&M gradient for these systems is assumed to be zero because the labor costs would not increase with the capacity of the system. Operation and maintenance of Alternatives 2 and 5 is more costly because of the electrical, labor, and material and supply costs required to operate the pump stations.

The service life of the facilities is assumed to be 50 years. Assuming the value of the facilities depreciates linearly with time, at the end of the 20 year design period the salvage value will equal 30/50 of the original value.

6.3 EXPLANATION OF PRESENT WORTH ANALYSIS FOR SITE DEVELOPMENT

A present worth analysis for site development costs has been prepared for each of the prospective sites. A summary of this analysis is presented in Table 6-4. The items of concern in this analysis are stream relocation and restoration, flood protection, dikes, and available land. The costs of general site clearing, grading, etc., have not been included in this analysis as they would be common to all sites. Land costs have been assumed to be $2,500 per acre at each site.

6.4 EVALUATION OF INTERCEPTOR ALTERNATIVES

The least costly alternative based on present worth analysis is Alternative 5. The total present worth is $1,766,600. The low cost of this alternative is due to a high salvage value at the end of the design period. Because flow in the southwest and southeast interceptors can presently be routed through the City of Bloomington to the Winston Thomas Plant, the main interceptor need not be constructed until 1985. Therefore, by 1995, only 10 years of the 50 year useful life of the sewer pipe will be exhausted.

Estimates for the capital costs of the pump stations indicated that a 3.5 MGD station should cost $600,000.[1] Experience with similar pump stations has indicated that these figures are not adequate to cover the cost. Consequently, the cost of the 3.5 MGD station was estimated at $1,000,000 and the 6.5 MGD station at $1,400,000.

The second least costly alternative is Alternative 4. This ranking is caused by Alternative 4 having the shortest interceptor length and no pump stations.

Alternative 3 is third least costly. It is similar to Alternative 4 except that 10,000 additional feet of interceptor would have to be installed to reach the Ketcham Road plant site.

Alternatives 1 and 2 both utilize the Salt Creek plant site. Because of the much greater length of interceptor required to reach this site, these alternatives are the most costly. Under Alternative 2, assumptions similar to those in Alternative 5 had to be made regarding capital costs of pump stations. Therefore, the graphic takeoff cost of 1.3 million for a 15 MGD pump station[2] was thought to be inadequate and the estimated cost was adjusted to 2.5 million for the 15 MGD pump station.

A summary of the present worth costs is given in Table 6.1.

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[1] "Estimating Costs & Manpower Requirements for Conventional Wastewater Treatment Facilities," Black & Veatch, U.S. Environmental Protection Agency, Act 1971.

"Basis of Cost Estimates," Camp, Dresser & McKee, Pennsylvania Department of Environmental Resources, COWAMP Studies, March 8, 1974.

[2] Some of the cost estimates are for 15 MGD capacity and others are for 16 MGD. The 1.0 MGD discrepancy reflects the projected additional flow from the Lake Monroe District. The comprehensive cost table (Table 6-6) is based on 15 MGD because it would not be feasible to transport the Lake Monroe flow to most of the treatment plant sites.

6.5 WASTEWATER TREATMENT SYSTEMS

This discussion is limited to the liquid treatment portion of the wastewater disposal process. Sludge handling alternatives and costs are discussed in another section.

The Consultant recommends the use of a complete mix activated sludge plant without the use of primary clarifiers. The plant process includes raw wastewater pumping, preliminary treatment, clarification, dual media filtration, and disinfection. Phosphorus removal would occur in the clarification basins. A flow equalization basin is included to reduce peak flows.

The only variation in liquid treatment process would be the use of a single stage activated sludge system for a plant located along Salt Creek as opposed to a two stage activated sludge system for a plant located along Clear Creek. Costs for the liquid treatment portion of the plant for both two stage and single stage systems have been calcuatled and are summarized in Table 6-5.

Construction and operating cost data was determined from "Estimating Costs and Manpower Requirements For Construction of Wastewater Treatment Facilities" with the exception of flow equalization and filtration costs. These costs were determined from "Flow Equalization - EPA Technology Transfer Seminar Publication" and "Advanced Wastewater Treatment Seminar Manual" by Culp, Wesner and Culp. These sources were required because flow equalization and filtration costs were not available in the "Estimating ... " reference. Construction costs for the aeration and clarification units were derived from take off and manufacturers' quotes as they were necessary for the pure oxygen versus air cost analysis.

Costs also included in this discussion are clearing and grubbing, piping, roadways, structures, electrical work, heating, ventilating and plumbing.

6.5.1 LAND APPLICATION ALTERNATIVE FOR BLOOMINGTON

The area within a 10-mile radius of the existing Winton-Thomas plant was evaluated for potential sites for land application of treatment sewage effluent. All wastes would receive a minimum of secondary treatment before application to the land. (The area north of Bloomington, which drains into Bean Blossom Creek was eliminated since pumping of the total flow of 15 MGD would be necessary to cross the drainage divide.) The following parameters were considered in the evaluation: soil depth, soil permeability, geology and topography.

Soils in the Bloomington area are of variable depth, ranging from 2-20 feet in the vicinity of Lake Monroe. The U.S. Department of Agriculture Soil Map for Monroe County indicates the frequent occurrence of shallow soils (2-4 feet) in the Bloomington area.

Since land application of treated sewage effluent requires a uniform minimum soil depth of 5-6 feet, certain measures would likely be needed to insure proper effluent treatment. Such measures might include underdrains or use of more than one application site with minimum soil depth requirements.

The major soils found in the Bloomington area are silt loams. Because these soils are relatively fine-grained, their permeability is generally poor. For land application systems, a relatively permeable soil is needed to allow for percolation and removal of nutrients from the effluent.

The Bloomington area is underlain by cavernous Mississippian limestones. A number of quarries and caves are presently in the vincinity, and sinkholes, some of which are filled with water, are abundant. Since much of the drainage in this area is underground, special attention would need to be given to site location to insure that improperly treated effluent would not enter surface streams.

The topography of the Bloomington area is rugged and is characterized by steep-sided streams valleys. Since land application requires a relatively flat area to minimize soil erosion and surface runoff, potential application sites in the Bloomington area would be severly limited by the topography.

A land application system serving a 15 MGD treatment plant would require 4000 to 7000 acres of land, and based on the physical parameters evaluated, there are no areas of this size within ten miles of the existing treatment facility. Therefore, it can be concluded that the area within ten miles of the Winston-Thomas plant is not conducive to land application of sewage effluent.

A potential site was located outside of the ten mile radius about seven miles southwest of the Salt Creek site by Black and Veatch in the Bloomington 201 Facilities Plan. However, the great length of effluent line required between the other proposed treatment plant sites along Clear Creek and this disposal site renders the land application alternative not cost-effective for Clear Creek sites.

Cost calculations for a transport, storage, capacity and spray irrigation system with secondary treatment by complete mix activated sludge (CMAS) are compared with other liquid treatment alternatives for the Salt Creek site in Table 6-10[1]. The present worth cost of the land application alternative (2C) is approximately twice that of other liquid treatment alternatives for the Salt Creek site evaluated in the Facilities Plan.

1 Black & Veatch Facilities Plan for Bloomington, Indiana - Lake Monroe Area, 1974.

In summary, because of the unavailability of a suitable site (based on physical parameters), land application of treated sewage effluent is not feasible for any of the proposed treatment plant sites except the Salt Creek site. Furthermore, the high cost figures for land application indicate that even if the Salt Creek location were chosen, land application is not the most cost-effective alternative.

6.5.2 NO ACTION ALTERNATIVE

The no action alternative for the South Bloomington Service Area would result in continued use of the Winston Thomas STP. As indicated in Chapter 1, the present flow of 11.2 MGD exceeds the design capacity resulting in a poor quality effluent.

The no action alternative would not enable the City of Bloomington to meet NPDES standards consistent with P.L.92-500 and would result in a continuously poor water quality in Clear Creek.

6.6 PRESENT WORTH ANALYSIS - SMITHVILLE AND SANDERS

A present worth analysis was made of the following two alternatives for providing sewage service to the communities of Smithville and Sanders.

1. Treatment at the Dillman plant site with the necessary pump station, force main and gravity lines.

2. Treatment at the Caslon treatment plant at an expanded capacity of 0.6 MGD and necessary gravity interceptor to reach the Caslon plant.

6.6.1. ALTERNATIVE NO. 1 SEWAGE TREATMENT AT DILLMAN ROAD

In order to convey Smithville and Sanders wastewater to the Dillman site, it is estimated that one pump station with 6,500 lineal feet of 4 inch force main and 5,500 lineal feet of 8" gravity sewer would be required.

Smithville and Sanders would be responsible for their share of the project and operating costs of the Dillman plant. The Dillman plant will be 15 MGD and Sanders Smithville ultimate flow is expected to be 80,000 gpd. Therefore, their share of the Dillman costs would be .08/15 or 0.53 of the costs.

6.6.2. ALTERNATIVE NO. 2 SEWAGE TREATMENT AT THE CASLON TREATMENT PLANT

In order to reach the plant, 18,500 feet of 8" gravity interceptor would be required. The Caslon plant presently has a capacity of 0.09 MGD. The 20 year growth projection for the Caslon Development is 0.5 MGD. For the purposes of this analysis, it was also assumed that Harrodsburg (.04 MGD) and the communities of Smithville and Sanders (.08 MGD) to the north would also join in this plant. Therefore, .5 MGD of additional capacity would be required at the Caslon plant. Smithville would be responsible for .08/.6 or 14% of those costs. Also, a relief outfall sewer would be required as a result of the additional flows.

The present worth analysis, summarized in Table 6-7, reveals that it is more economical for Smithville and Sanders to convey and treat their waste at the Dillman site.

It would still be possible for the Harrodsburg area to be served by the existing Caslon Development plant on Little Clear Creek. Another possibility, if Harrodsburg would be served by the plant, would be to move the plant to an alternate location at the confluence of Clear Creek and Little Clear Creek.

6.6.3. FAIRFAX

A construction and project estimate was made for conveying wastewater from Fairfax to the plant serving the Caslon Development (The Pointe). It was assumed that three pump stations would be required and 2,000 feet of 8" gravity sewer with 16,000 feet of 4" force main. It was also assumed that use of the existing interceptor would be made by Fairfax although no costs were added for their proportionate share. A construction cost of $486,000 and project cost of $632,000 were estimated. (The Indiana State legislature has appropriated 300,000 to design and construct an interceptor connecting the Fairfax Recreation Area to the Caslon lift station with treatment at the Caslon package plant.) The Caslon interceptor was originally sized to accommodate flows from the Fairfax Recreation Area.

6.7 PROJECT COSTS

Table 6-8 presents a summary of project costs (excluding sludge disposal) for the various alternative sites. The project cost represents the capital cost of the project times a 1.3 factor for engineering, legal, and miscellaneous costs of completing construction. The table shows the Dillman Road site to have the lowest project cost of the alternatives.

TABLE 6-1

COST OF INTERCEPTOR SEWER ALTERNATIVES

						PRESENT WORTH			
Alternative No.	Capital Cost (1)	O & M (11 MGD) (2)	O & M (15 MGD) (3)	O & M Gradient (4)	Salvage Value (5)	Project Cost (6)	O & M (7)	Salvage Value (8)	Total Present Worth (9)
1.	16,212,000	1,125	1,125	0	12,645,400	21,075,600	12,900	3,867,000	17,221,500
2.	14,232,700	60,800	83,000	1,110	11,101,500	18,502,500	793,000	3,395,000	15,900,500
3.	4,706,700	560	560	0	3,671,200	6,118,700	6,400	1,123,000	5,002,100
4.	2,179,000	560	560	0	1,700,000	2,832,700	6,400	520,000	2,319,100
5.	4,240,200	20,100	27,500	740[1]	4,410,000[2]	3,023,000[3]	92,600[4]	1,349,000	1,766,600
5A.	4,240,200	23,200	31,600	1,680	4,961,000	2,262,000[5]	45,400[6]	1,517,000	790,400
5B.	0	0	0	0	0	0	0	0	0

Col. 4 = (Col. 3 - Col. 2)/20

Col. 6 = Col. 1 x 1.3

Col. 7 = Col. 2 (11.47) + Col. 4 (86.01)

Col. 5 = Col. 6 (30/50)

Col. 8 = Col. 5 (.3058)

Col. 9 = Col. 6 + Col. 7 - Col. 8

INTERCEPTOR SEWER ALTERNATIVES

ALTERNATIVE 1 - Gravity Interceptor to Salt Creek site via Clear Creek.

ALTERNATIVE 2 - Gravity Interceptor and force main to Salt Creek via Little Clear Creek.

ALTERNATIVE 3 - Gravity Interceptor to Ketcham Road site via Clear Creek.

ALTERNATIVE 4 - Gravity Interceptor to Dillman Road site via Clear Creek.

ALTERNATIVE 5 - Force main to South Rogers Street site via Clear Creek in 10 yrs.

ALTERNATIVE 5A- Force main to South Rogers Street site via Clear Creek in 15 yrs.

ALTERNATIVE 5B- Force main to South Rogers Street site via Clear Creek after year 2000

[1] O & M Gradient = (Col. 3 - Col. 2)/10

[2] Salvage Value = (Capital Cost x 1.3) (40/50)

[3] Project Cost = Col. 1 x 1.3 x (.5484)

[4] O & M = Col. 2 (7.31) (.5484) + Col. 4 (29.5) (.5484)

[5] P C = Col. 1 x 1.3 x (.4104)

[6] OM = Col. 2 (4.2) (.4104) + Col. 4 (7.89) (.4104)

TABLE 6-2

INTERCEPTOR DESIGN CRITERIA

A. Pipe

  1. Gravity Sewers

    a. Reinforced concrete
    b. Steel joints with O-ring gasket
    c. Size - 42" to 78" dia.

  2. Force Mains

    a. Ductile iron
    b. Tyton joint
    c. Size - 24" to 48" dia.

  3. Excavation

    a. Two-thirds of the distance from Winston-Thomas to Salt Creek Site is classified as rock excavation.
    b. Average trench depth - 10 feet.
    c. Trench width - pipe diameter plus two (2) feet.

B. Stream Crossings

  1. Length - 40 feet.
  2. Concrete encasement.

C. Railroad Crossings

  1. Length - 80'
  2. Tunnel

D. Highway Crossings

  1. Open cut.

TABLE 6-3

INTERCEPTOR COST GUIDELINES

A. Pipe

Size and Type	Price for Pipe & Labor*
24" DIP	$ 66 L/F
30" DIP	71
42" RCP	88
48" DIP	105
54" RCP	132
60" RCP	149
66" RCP	165
72" RCP	187
78" RCP	209

*Excavation and backfill not included

Rock Excavation	$25/C.Y.
Soil Excavation	$ 5/C.Y.
Backfill	$ 6/C.Y.

B. Manholes

$1,500 each

C. Pumping

1. Electricity - 2¢/kw-hr
2. Labor - $6/hr.

D. Stream Crossing

1. Pipe Prices - 1.5 X Standard Unit Prices
2. Excavation and Backfill

a. Rock Excavation - $50/C.Y.
b. Soil Excavation - $10/C.Y.
c. Backfill - $12/C.Y.

E. Railroad Crossings

Pipe Size and Type	Price for Pipe & Tunneling Operations
42" RCP	$230/L.F.
54" RCP	300
60" RCP	340
66" RCP	370
72" RCP	400

Excavation for boring pit - $2,000/Pit

TABLE 6-4

COST OF SITE DEVELOPMENT

Alternative	Land Cost	Construction Cost	Project Cost	Present Worth of Salvage Value	Total Present Worth	Rank
Winston Thomas	-	596,000	775,000	-	775,000	2
South Rogers	100,000	1,343,000	1,745,000	30,000	1,715,000	5
Dillman	150,000	601,000	781,000	45,000	736,000	1
Ketcham	150,000	726,000	943,000	45,000	898,000	4
Salt Creek	150,000	680,000	884,000	45,000	839,000	3
Salt Creek[1]	650,000			195,000	455,000	

[1] Accounts for the additional 260 acres of land available at Salt Creek.

TABLE 6-5

LIQUID TREATMENT PROCESS @ 15 MGD

	(1) Construction Cost	(2) O & M @ 11 MGD	(3) O & M @ 15 MGD	(4) O & M Gradient	(5) Salvage Value	(6) Project Cost	(7) Present Worth O & M	(8) Present Worth Salvage Value	(9) Total Present Worth
Complete Mix Activated Sludge - (Single Stage with Filtration)	$12,608,000	$527,000	$684,000	$ 7,850	$5,322,000	$16,130,000	$6,720,000	$1,628,000	$21,222,000
Additional Costs Associated with Two Stage Aeration	1,733,000	49,000	67,000	900	744,000	2,253,000	626,000	227,000	2,652,000
Complete Mix Activated Sludge (Two Stage with Filtration)	14,141,000	576,000	751,000	8,750	6,066,000	18,383,000	7,346,000	1,855,000	23,874,000

Column 4 O & M Gradient = $\frac{\text{Column 3 - Column 2}}{20}$

Column 5 Salvage Value = (Column 6) (10/30)
Column 6 Project Cost = (Column 1) (1.3)
Column 7 Present Worth, O & M = (Column 2) (11.47) + Column 4 (86.01)
Column 8 Present Worth, Salvage Value = (Column 5) (0.3058)
Column 9 Total Present Worth = Column 6 + Column 7 - Column 8

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TABLE 6-6

PRESENT WORTH ANALYSIS OF TREATMENT ALTERNATIVES @ 15 MGD

Alternatives	Interceptor	Site Development	Liquid Treatment	Sludge Treatment	Sludge Disposal	Total
Winston Thomas *	$ 1,767,000	$ 775,000	$23,874,000	$3,342,300(1)	$1,076,700	$30,835,000
South Rogers *	1,767,000	1,715,000	23,874,000	3,342,300(1)	1,076,700	31,775,000
Dillman	2,319,000	736,000	23,874,000	3,342,300(1)	1,076,700	31,348,000
Ketcham	5,002,000	898,000	23,874,000	3,342,300(1)	1,076,700	34,193,000
Salt Creek	17,222,000	839,000	21,222,000	1,769,96[illegible] (2)	1,418,000	42,489,000

(1) Assumes aerobic digestion and centrifuging followed by surface spreading.

(2) Assumes aerobic digestion followed by lagoon and soil injection.

* Assumes pumping stations and force main are required in 1985. See Table 6-1, alternatives 5A & 5B for present worth of Winston Thomas and South Rogers sites if force main and pump stations are required in 15 or 20 years respectively.

TABLE 6-7

PRESENT WORTH ANALYSIS
SMITHVILLE AND SANDERS

	Construction Cost	O&M	Salvage Value	Project Cost	PW of O&M	PW of Salvage Value	Total
Dillman							
Interceptor	302,000	6,700	235,000	393,000	77,000	72,000	398,000
Treatment Plant[1]							154,000
Total							$552,000
Caslon							
(1) Interceptor	500,000	-	389,000	649,000	-	118,000	$ 531,000
Treatment Plant and Outfall	848,000	105,000	366,000	1,099,000	846,000	112,000	1,833,000
(2) Smithville and Sanders Share (14%)							257,000
Total (1 & 2)							$ 788,000

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[1] Assumes 0.53% of present worth of all costs of Dillman Treatment Site excluding interceptor costs.

TABLE 6-8

PROJECT COSTS

	Winston-Thomas	South Rogers	Dillman Road	Ketcham Road	Salt Creek
Interceptors	3,023,000*	3,023,000*	2,832,700	6,118,700	18,502,500
Site Development	775,000	1,745,000	781,000	943,000	884,000
Liquid Treatment	18,383,000	18,383,000	18,383,000	18,383,000	16,130,000
Sludge Treatment**	1,787,500	1,787,500	1,787,500	1,787,500	886,600
Total	$23,968,500	$24,938,500	$23,784,200	$27,232,200	$36,403,100

* Present worth of 5.512 million dollars 10 years hence. See Table 6-1, column 6 for project cost in 15 and 20 years respectively.

** Project costs of aerobic digestion and centrifuge for all sites except Salt Creek which would have aerobic digestion and sludge lagoon.

Table 6-9

COST EFFECTIVENESS - TREATMENT ALTERNATIVES
(20 mgd capacity)

Alternative No.	Description*	Construction Cost	Interest During Construction	Engr., Legal Adm., & Other Costs	Total Project Cost (@ yr 2)	Equipment Cost (@ yr 17)	Remaining Value (@ yr 20)	Annual O&M Cost **	Present Worth
1A	Trickling Filter, Aerobic Digestion	$18,485,000	$ 1,800,000	$ 3,687,000	$23,972,000	$ 3,700,000	$12,422,000	$ 1,275,000	$30,226,000
1B	Trickling Filter, Dual Digestion	18,956,000	1,850,000	3,781,000	24,587,000	3,500,000	12,692,000	1,107,000	29,136,000
2A	CMAS w/o Primary	15,661,000	1,480,000	3,124,000	20,265,000	2,900,000	10,487,000	1,069,000	25,404,000
2B	CMAS w/o Primary, 2 Day Lagoon	14,585,000	1,350,000	2,909,000	18,844,000	2,800,000	9,782,000	905,000	22,856,000
2C	CMAS w/o Primary, Land Disposal	46,065,000	5,200,000	9,189,000	60,454,000	5,000,000	30,028,000	1,373,000	58,799,000
3A	CMAS w/Primary, Dual Digestion	16,582,000	1,580,000	3,308,000	21,470,000	3,200,000	11,124,000	1,082,000	26,503,000
3B	CMAS w/Primary, Aerobic Digestion	16,523,000	1,570,000	3,296,000	21,389,000	3,400,000	11,119,000	1,309,000	28,515,000
4	Extended Aeration	18,893,000	1,830,000	3,769,000	24,492,000	4,000,000	12,732,000	1,286,000	30,794,000
5	Physical/Chemical	21,746,000	2,150,000	4,338,000	28,234,000	7,500,000	15,117,000	1,421,000	35,769,000

* See text for more detailed description of each alternative.

** O&M last 18 years.

CMAS - complete mix activated sludge

Source: Black & Veatch, Bloomington 201 Facilities Plan

TASK 7

DISTRIBUTION OF COSTS

The initial purpose of this task was to identify costs for a regional treatment facility serving both Bloomington and the Lake Monroe Area and to break those costs down to each service area, namely Bloomington and Lake Monroe. However, based on the discussions in other tasks of this report, such a regional plant is not recommended, and hence a detailed breakdown of costs is not needed.

The Consultant has recommended that a 15 MGD plant be built on the Dillman Road plant site with the necessary interceptor from Bloomington. An analysis of Lake Monroe has revealed that it is less costly for the communities of Sanders and Smithville to have their wastewater treated at the Dillman site rather than at the Caslon site. Smithville - Sanders will require 80,000 gallons per day (0.08 MGD) of treatment plant capacity.

If the City of Bloomington and Smithville - Sanders agree to build a plant on the Dillman site, both project and operating costs will be shared. As stated previously, the plant should have a capacity of 15 MGD, and Smithville - Sanders will be responsible for .08/15 = 0.53% of the project and operational costs at design capacity. Each community will be responsible for its own interceptor to reach the plant.

Table 7-1 shows the sharing of costs for the respective shares of the plant costs and individual interceptor costs.

It should be noted that this analysis does not list the collection system project costs for Sanders and Smithville.

A sewage collection system for the Sanders-Smithville area would, of course, be needed. A very rough approximation of the cost for such a system is based on 27,000 lineal feet of sewer line at an in-place construction cost of $25 per foot. This would produce an approximate construction cost for the collection sewer system of $675,000, or a total project cost of approximately $877,500. Assuming receipt of a federal grant for 75 percent of the cost and a state grant for 10 percent of the cost, the local share of the project cost would be $131,625.

TABLE 7-1

COST SHARING FOR DILLMAN ROAD PLANT SITE

	Project Cost	O&M @ 11 MGD
Treatment @ 15 MGD		
Bloomington	$ 16,776,000	$ 524,000
Smithville and Sanders	89,000	3,000
Total	$ 16,865,000	$ 527,000
Interceptors and Pumping Station		
Bloomington	$ 2,833,000	$ 1,000
Smithville and Sanders	393,000	8,000
Bloomington Total Costs	$ 19,599,000	$ 532,000
Smithville/Sanders Total Costs	$ 482,000	$ 11,000

NOTE: Project cost for sewage collection system for Smithville and Sanders would be approximately $877,500.

Total project cost for collection, interceptors and treatment = 1,359,500

Assuming 75% federal grant, 10% state grant:

Local Share = $203,925

Annual Cost, assuming 20 years at 6½% = $17,960

TASK 8

SLUDGE TREATMENT AND DISPOSAL

8.1 INTRODUCTION AND SUMMARY

A major problem facing the designer of any sewage treatment plant today is the ultimate disposal of the solids removed in the treatment processes. Environmental regulations concerning the disposal of sewage treatment plant sludges are becoming increasingly stringent as adverse effects of past disposal practices become known. In investigating sludge handling alternatives for the new Bloomington south treatment plant, a number of treatment and disposal processes were evaluated. The sludge volume to be produced by the proposed plant was first calculated, and costs for the various handling processes were then determined.

Potential sludge disposal sites in the Bloomington area were investigated by examining topographic maps, aerial photographs and soils maps. It was determined that with the recommended agronomic loading rates there would not be sufficient land available at the Salt Creek site to sustain land application of all sludge produced at the plant for the 20 year planning period.

The least costly alternative for sludge handling and disposal at the recommended Dillman Road site is aerobic digestion followed by a sludge lagoon with ultimate disposal by soil injection. This arrangement, however, limits future flexibility for sludge disposal, since other methods of disposal (composting, landfilling) require a higher solids concentration than soil injection (20% solids vs 10% solids). More flexibility could be built into the system by adding centrifuging instead of the sludge lagoon, even though the costs, both initial and operating, would be higher. This would provide the flexibility of being able to use other methods of sludge disposal such as composting, landfilling, or land application.

The alternative of composting was considered for sludge disposal because of the proximity of the Scarab Composting Company and the recent request by Scarab to take large volumes of sewage treatment plant sludge. The Scarab offer appears quite attractive since the city would do away with much of its problem of ultimate disposal, and a useful product would result from the operation. However, the city should approach composting with some caution for several reasons:

1. The history of composting operations in the U.S. is not good. Most operations have failed.

2. The composting system must be extremely reliable, or provisions must be made to stockpile the sludge. Sludge will be produced every day and must be placed somewhere.

3. The city would still be responsible for disposal of the sludge in the event the composting operation were shut down.

Landfilling or land application would be viable alternatives should the composting arrangement fail.

8.2 SLUDGE PRODUCTION

The daily sludge volume produced by the proposed treatment plant was calculated by performing a mass balance analysis on the treatment plant. The assumptions and calculations used in this analysis are listed below.

Influent:

Flow = Q = 15 MGD
BOD = 144 MG/L = 18,020 #BOD/Day
SS = 180 MG/L = 22,520 #SS/Day

Assume: 95% BOD and SS removal efficiencies

A. Biological Sludge Production

Effluent:

BOD = 7 MG/L = 876 #BOD/Day
SS = 9 MG/L = 1126 #SS/Day

Sludge Produced:

BOD = 18,020 #/Day - 876 #/Day = 17,144 #BOD/Day
SS = 22,520 #/Day - 1126 #/Day = 21,394 #SS/Day

Assume:

0.5 #VSS Produced per #BOD Removed

17,144 #BOD/Day x 0.5 #VSS/#BOD = 8572 #VSS/Day

Biological Sludge Production = 21,394 #SS/Day + 8572 #VSS/Day
= 29,966 #Dry Solids/Day

B. Chemical Sludge Production for Phosphorus Removal

Influent:

4 MG $PO_{4/L}$ = 1.3 MG P/L

80% Removal Required.

Effluent:

1.3 MG P/L X 0.2 = 0.26 MG/L

P Removed = 1.0 MG/L

Stoichiometric Relationship for Aluminum (AL) to P is:

0.87/1 by Weight

Assume: 2.2 AL/1.0 P Ratio because of competing reactions and Low P Concentration. Aluminum Sulfate ($AL_2\ SO_4$) = 9% AL

$$\frac{1.0\ AL_2\ SO_4}{0.9\ AL} \quad X \quad \frac{2.3\ AL}{1.0\ P} = \frac{26.0\ AL_2\ SO_4}{1.0\ P}$$

$$\frac{26.0\ AL_2\ SO_4}{1.0\ P} \quad X \quad 1.0\ P \quad X \quad 8.34 \quad X \quad 15\ MGD = 3255$$

$\#AL_2\ PO_4/Day$

Since additional alum was added in excess of the Stoichiometric requirements, $AL(OH)_3$ will be formed.

Stoichiometric Requirement

$$\frac{0.87\ AL}{1.0\ P} \quad X \quad \frac{1.0\ AL_2\ SO_4}{0.09\ AL} = 10\ MG\ AL_2SO_{4/L}$$

Excess Alum = 26.0 MG/L - 10 MG/L = 16.0 MG/L

$AL(OH)_3$ Produced = 16.0 MG AL_2SO_4 X $\frac{156}{600}$ =

4.2 MG $AL(OH)_{3/L}$

Pounds $AL(OH)_3$ Produced = 4.2 MG/L X 8.34 X

15 MGD = 525 $\#AL(OH)_{3/Day}$

Total Chemical Sludge Production:

3255 $\#AL_2PO_{4/Day}$ + 525 $\#AL(OH)_{3/Day}$ = 3780 # Dry Solids/Day

C. Total Sludge Production = Biological + Chemical

29,966 #/Day + 3780 #/Day = 33,748 $\frac{\text{\# Dry Solids}}{\text{Day}}$

Use 33,750 # Dry Solids/Day

Assume: Solids Concentration from the Clarifier = 2% = 20,000 MG/L

$$\text{Flow} = \frac{\text{Solids Production, \#/Day}}{\text{Solids Concentration, MG/L X 8.34}}$$

$$= \frac{\text{33,750 \#/Day}}{\text{20,000 MG/L X 8.34}}$$

= 0.20 MGD

Summary:

Flow = 0.20 MGD
Solids Concentration = 20,000 MG/L Total Solids

VSS normally equals 75% of TSS in a Biological Sludge. Due to the addition of Chemical Sludge Assume VSS = 73% TSS

Solids Production = 33,750 #TSS/Day
= 24,640 #VSS/Day

8.3 UNIT PROCESSES

Figure 8-1 presents eleven unit processes for sludge stabilization, dewatering, drying and disposal. The size and cost of each process appears in the following pages. The design criteria and assumptions are based on design recommendations appearing in Metcalf and Eddy, Inc., Wastewater Engineering, McGraw - Hill Book Co., 1975.

8.3.1 Aerobic Digestion

8.3.1.1 Aerobic Digester Design

Design Criteria:

SRT = 20 Days
Solids Loading = 0.024 - 0.14 $\#VS/FT^3/Day$
Oxygen Requirements = 2 $\#O_2/\#VSS$

Energy For Mixing

Mechanical Aerators - 0.5-1.0 hp/1000 FT^3

Air Mixing - 20-35 SCFM/1000 FT^3

Volume of Sludge

Assume: Specific Gravity = 1.03

$$\text{Volume} = \frac{33{,}750\#}{1.03\ (62.4)(0.02)} = 26{,}260\ FT^3/Day$$

Volume of Digester

$$V = 26{,}260\ FT^3/Day \times 20\ Day = 526{,}000\ FT^3$$

Check Solids Loading

$$\#VS/FT^3/Day = \frac{24{,}640\ \#VS/Day}{526{,}000\ FT^3} = \underline{\underline{0.05}} \qquad \underline{\text{Check}}$$

O_2 Requirements

Assume: 40% VSS Reduction

$\#O_2/\text{Day} = 24{,}640\ \#\text{VSS/Day}\ (0.40)\ (2.0\ \#O_2/\#\text{VSS})$
$= 19{,}720\ \#O_2/\text{Day}$

Volume of Air

$$\frac{19{,}720}{0.075\ (0.232)} = 1.13 \times 10^6\ \text{FT}^3/\text{Day}$$

Assume: 10% Transfer Efficiency

$$\text{Air Requirement} = \frac{1.13 \times 10^6\ \text{FT}^3/\text{Day}}{(0.10)\ (1440)} = 7870\ \text{CFM}$$

Air/1000 FT^3 of Digester

$$\frac{7870\ \text{CFM}}{526} = 15\ \text{CFM}/1000\ \text{FT}^3$$ TOO LOW FOR ADEQUATE MIXING

Mixing Requirements Govern

30 SCFM/1000 FT^3

Air Requirement = 15,780 SCFM

8.3.1.2 Aerobic Digested Sludge

Assume: 4% Solids Concentration
40% Volatile Solids Reduction
24,640 #/Day X 0.40 = 9860 #VSS/Day
Total Solids = 33,750 #TSS/Day - 9860 #VSS/Day = 23,900 #TSS/Day

$$\text{Flow} = \frac{23{,}900\ \#/\text{Day}}{40{,}000\ \text{MG/L} \times 8.34} = 0.072\ \text{MGD}$$

Summary:
Flow = 0.072 MGD
Solids Concentration = 40,000 MG/L
Solids Production = 23,900 #Dry Solids/Day

8.3.2 Anaerobic Digestion

8.3.2.1 Anaerobic Digester Design

Assume:
Heated Digester
Solids Retention Time = 15 Days
40% Volatile Solids Reduction
Specific Gravity CF Sludge = 1.03

$$\text{Sludge Volume} = \frac{33{,}750\ \#/\text{Day}}{(1.03)(62.4)(0.02)} = 26{,}260\ \text{FT}^3/\text{Day}$$

Digester Volume = (Sludge Volume) (Solids Retention Time)

$= (26{,}260\ \text{FT}^3/\text{Day})\ (15\ \text{Days})$

$= 394{,}000\ \text{FT}^3$

8.3.2.2 Anaerobic Digested Sludge

Assume: 4% Solids Concentration

Summary:

Flow = 0.072 MGD
Solids Concentration = 40,000 MG/L

Solids Production = 23,900 #Dry Solids/Day

8.3.3 Sludge Lagoon

Flow = 0.072 MGD = 9630 FT^3/Day
Solids Retention Time = 1 year = 365 days

Volume of Lagoon = 9630 FT^3/Day (365 days)

$= 3{,}520{,}000\ \text{FT}^3$

Assume:

No Solids Reduction
10% Effluent Solids Concentration

$$\text{Flow} = \frac{23{,}900\ \#\text{Dry Solids/Day}}{(100{,}000\ \text{MG/L})\ (8.34)}$$

$= 0.029$ MGD

Summary:

Flow = 0.029 MGD
Solids Concentration = 100,000 MG/L
Solids Production = 23,900 $\frac{\#\text{Dry Solids}}{\text{Day}}$

8.3.4 Sand Drying Bed

Assume: Loading Rate = 20 #Dry Solids/FT^3/Year

Solids Production = 23,900 #/Day = 8,725,000 #/Year

$$\text{Drying Bed Surface Area} = \frac{8{,}725{,}000\ \#/\text{Year}}{20\ \#/\text{FT}^2/\text{Year}}$$

$= 436{,}250\ \text{FT}^2$
$= 10.0$ Acres

Assume: 30% Solids Concentration

$$\text{Volume of Sludge} = \frac{23{,}900\ \#/\text{Day}}{1.03\ (62.4)(0.30)}$$

$$= 1240\ \text{FT}^3/\text{Day}$$

8.3.5 Incineration

Assume: 80 Hours/Week Operating Time

Solids Production = 33,750 #/Day = 236,250 #/Week

$$\text{Feed Rate} = \frac{236{,}250\ \#/\text{Week}}{80\ \text{Hours/Week}}$$

$$= 2950\ \#\text{Dry Solids/Hour}$$

Assume: Sludge Feed Characteristics

Solids Concentration = 200,000 MG/L
VSS = 73% of Total Solids

Assume: 0% Moisture Content in Ash

Density = 2000 #/YD^3

Summary: 2.3 Tons of Ash/Day

$$\frac{4300\ \#\text{Ash/Day}}{2000\ \#/\text{YD}^3} = 2.15\ \text{YD}^3\ \text{Ash/Day}$$

$$= 58\ \text{FT}^3\ \text{Ash/Day for Disposal}$$

8.3.6 Centrifuge

Assume: 40 Hours/Week Operating Time

Solids Production = 23,900 #/Day
Flow = 0.072 MGD = 504,000 Gallons/Week

$$\text{Feed Rate} = \frac{504{,}000\ \text{Gallons/Week}}{40\ \text{Hours/Week}}$$

$$= 12{,}600\ \text{Gallons/Hour}$$

$$= 210\ \text{GPM}$$

Sludge Cake Summary:

Flow = 0.014 MGD
Solids Concentration = 200,000 MG/L
Solids Production = 23,900 $\frac{\#\text{Dry Solids}}{\text{Day}}$

8.3.7 Vacuum Filter

Assume: Yield Rate = 3.5 #/FT^2/Hour
40 Hours/Week Operating Time

Solids Production = 23,900 #/Day = 167,300 #/Week

$$\text{Surface Area of Vacuum Filter} = \frac{167{,}300\ \#/\text{Week}}{(40\ \text{Hours/Week})(3.5\ \#/\text{FT}^2/\text{Hour})}$$

$$= 1200\ \text{FT}^2$$

Sludge Cake Summary:

Flow = 0.014 MGD
Solids Concentration = 200,000 MG/L
Solids Production = 23,900 $\frac{\#\text{Dry Solids}}{\text{Day}}$

8.3.8 Thickener

Assume: Solids Loading Rate = 10 #/FT^2/Day

Solids Loading = 33,750 #/Day

$$\text{Surface Area of Thickener} = \frac{33{,}750\ \#/\text{Day}}{10\ \#/\text{FT}^2/\text{Day}}$$

$$= 3375\ \text{FT}^2$$

Assume: 6% Solids Concentration
No Solids Reduction

Summary:

Flow = 0.067 MGD
Solids Concentration = 60,000 MG/L
Solids Production = 33,750 $\frac{\#\ \text{Dry Solids}}{\text{Day}}$

8.4 SLUDGE TREATMENT ALTERNATIVES

Utilizing the information developed in the Unit Process Section, nine Sludge Treatment Alternatives were evaluated. The alternatives are as follows:

Alternative	Unit Processes	Solids Requiring Disposal Tons Dry Solids/Day	Solids Requiring Disposal FT^3/Day
1	Aerobic Digester Sludge Lagoon	11.95	3720
2	Aerobic Digester Vacuum Filter	11.95	1870
3	Thickener Vacuum Filter Incineration	2.15	58
4	Aerobic Digester Centrifuge	11.95	1870
5	Thickener Aerobic Digester Sand Drying Bed	11.95	1240
6	Anaerobic Digester Sludge Lagoon	11.95	3720
7	Anaerobic Digester Vacuum Filter	11.95	1870
8	Anaerobic Digester Centrifuge	11.95	1870
9	Thickener Anaerobic Digester Sand Drying Bed	11.95	1240

All of the nine alternatives shown above could be used at any of the proposed treatment plant sites for sludge treatment. Each alternative requires the disposal of solids, which will be covered in the next section.

Table 8 -1 presents the capital cost, annual operation and maintenance cost, salvage value and the present worth for each unit process.

Table 8 -2, "Alternative Sludge Treatment Cost," presents the total present worth of the sludge treatment alternatives. The alternatives are ranked on the basis of total present worth.

8 .5 SLUDGE DISPOSAL ALTERNATIVES

8 .5.1 Composting

Three alternatives for sludge disposal were investigated. The first alternative is hauling the sludge to the Scarab composting site. The present worth of the hauling costs are as follows:

Plant Site	Present Worth
Winston Thomas	$ 161,700
Dillman	$ 156,900
Ketcham	$ 226,000
Salt Creek	$ 349,600

It was assumed that the sludge would have to be at a minimum of 20% dry solids, therefore, sludge treatment alternative #4 was used in calculating the total sludge treatment and disposal cost for composting.

8.5.2 Soil Injection or Land Application

The second alternative is hauling the sludge via existing roads to a centralized distribution point located south of the Valley Mission Church in Lawrence County. The present worth of the hauling cost are as follows:

Assuming sludge at 10% dry solids

Plant Site	Present Worth
Winston Thomas	$ 682,400
Dillman	$ 582,800
Ketcham	$ 549,600
Salt Creek	$ 412,300

Assuming sludge at 20% solids

Present Site	Present Worth
Winston Thomas	$ 342,500
Dillman	$ 292,400
Ketcham	$ 276,000
Salt Creek	$ 207,000

The sludge is transferred from the hauling vehicle to an application vehicle at the land disposal site. The application vehicle would inject the 10% solids sludge into the soil and spread the 20% solids sludge on the soil surface. The present worth of the sludge application cost are as follows:

Sludge Concentration	Present Worth
10%	$ 736,300
20%	$ 734,200

8.5.3 Sludge Lagoons

The third alternative is construction of sludge lagoons for the disposal of the sludge. The costs for lagoons with 20 years capacity and the costs for lining the lagoons were calculated. The present worth of the lagoons are as follows:

	PRESENT WORTH	
Lagoon Capacity	With Liner	Without Liner
20 Years	$ 2,975,400	$ 1,781,500

8.5.4 Land Requirements for Injection or Surface Spreading

Sludge disposal alternative #2, land spreading requires a large land area. The calculations are as follows:

Sludge Production = 11.95 Tons Dry Solids/Day
= 4362 Tons Dry Solids/Year

8.5.4.1 Application Rate

Heavy Metals Criteria:

Equation - Total Quantity of Dry Solids, Tons/Acres

$$\text{Tons/Acre} = \frac{\text{CEC (meq/100g Unamended Soil) X } 1.63 \text{ X } 10^4}{[1 \text{ X } (\frac{\text{mgZn}}{\text{Kg Sludge}} - 50) + 2 \text{ S } (\frac{\text{mgCu}}{\text{Kg Sludge}} \; 25) + 8 \text{ X } (\frac{\text{MgNi}}{\text{Kg Sludge}} - 25)]}$$

Assume: CEC = 25 meq/100g Unamended Soil

Use Winston Thomas sludge heavy metal analysis of September 17, 1975.

Element	Concentration, MG/KG Dry Weight
Cu	980
Cr	585
Fe	5940
Ni	282
Cd	29
Zn	430

Using these assumptions, the total quantity of dry solids equals 90 Tons/Acre.

Therefore, the annual application rate for the twenty year design life equals 4.5 Tons Dry Solids/Acre/Year.

Use 5.0 Tons Dry Solids/Acre/Year

Agricultural Plant Growth Requirements:

Using equations in EPA's proposed sludge disposal guidelines, it was calculated that the annual sludge application rate for plant growth requirements would be approximately 5 Tons Dry Solids/Acre/Year.

Therefore, the land requirements for land disposal are as follows:

$$\text{Land Area} = \frac{\text{4362 Tons Dry Solids/Year}}{\text{5 Tons Dry Solids/Acre/Year}} = \text{873 Acres}$$

Because of the large land area requirements for land disposal, it is recommended that Bloomington should not purchase the land at the Salt Creek Site for disposal purposes. It was assumed that the sludge would be spread on farmland as it is done at the Bucher-Poole Plant. Due to the lack of available data, it was assumed that the sludge would be spread on farmland located on the Salt Creek Flood Plain from the Salt Creek Plant site to areas located in Lawerence County. Because the sludge is assumed to be hauled in 20 Ton loads by trailer trucks, primary roads were chosen in determining the distances to the disposal site from the various plant sites.

It is recommended that the sludge not be applied in excess of the agronomic rate because of the possibility of nitrate leaching. This is also within the limits of the proposed EPA sludge disposal guidelines which will probably be enforced in the near future.

8.5.5 Hauling Costs

Table 8-3 presents hauling costs for land disposal and composting. It was assumed that Bloomington would contract with a hauling firm to transport the sludge and that a trailer truck with a 20 ton load limit would be used.

Table 8-4 presents the cost for the application vehicle. The capital and operation and maintenance costs were obtained from Mr. Rich Schapland, Big Wheels, Inc., Paxton, Illinois.

Application Vehicle Cost

	10% Solids Concentration Sludge Injection	20% Solids Concentration Surface Spreading
Capital Cost of Vehicle	$ 37,000	$ 33,000
Annual Capital Cost 6.125% Interest 5 Year Life	49,802	44,418
Annual Cost O & M (insurance, tires, truck maintenance, etc.)	1,000	1,000
Fuel Cost 8 Gallons/hour $.55/Gallon 1600 Hours/year	7,040	7,040
Operator $6.00 Hour 1600 hours/year	9,600	9,600
Total Annual Cost Year 20	67,442	62,058
Total Annual Cost Year 1	62,242	56,858
Total Present Worth	736,300	734,200

8.5.6 Sludge Lagoon Costs

Sludge lagoon costs are as follows:

ANNUAL COST

	Capital Cost	O & M 11 MGD	O & M 16 MGD	O & M Gradient	Salvage Value
Without Liner	$1,228,200	39,000	46,000	350	958,000
With Liner	2,353,200	39,000	46,000	350	1,835,500

PRESENT WORTH

	Project Cost	O & M	Salvage Value	Present Worth
Without Liner	$1,597,000	477,500	293,000	1,781,500
With Liner	3,059,200	477,500	561,300	2,975,400

The 20 year capacity lagoon would require 90 acres of land. Therefore, it was assumed that the lagoons could only be utilized at the Salt Creek site.

8 .6 CONCLUSION AND RECOMMENDATIONS

Table 8 -5 presents the Summary of Sludge Treatment and Disposal Costs. The sludge treatment alternatives, aerobic digester-lagoon and aerobic digester-centrifuge have the lowest present worth for producing sludge at 10% and 20% solids concentration, respectively. Composting has the lowest present worth of the disposal alternatives but it requires treating the sludge to 20% solids. Therefore, this combined treatment and disposal alternative is not the most economical alternative.

The least cost combined treatment and disposal alternative at each site is treating to 10% solids and soil injection. This is assuming that land is available for soil injection at no cost to the City of Bloomington.

It should be pointed out that the 20 year capacity unlined lagoon and the aerobic digester alternative is the least costly alternative at the Salt Creek Site but the land area requirements of the lagoons is too great for inclusion at the other sites. However, if a lagoon site could be found within reasonable distance from the other plant sites, this could become a viable alternative at the other plant sites.

To provide the most flexibility and reliability, it is recommended that the sludge be treated to 20% solids via aerobic digestion and centrifugation. This would allow disposal via composting, landfilling and/or surface spreading. Therefore, should the composting arrangement fail, the City of Bloomington would have alternative disposal mechanisms readily available.

Soil injection of the 10% sludge is the least cost alternative for sludge disposal. This is predicated on the assumption that Bloomington will not purchase the disposal land.

However, due to the land area requirements and the unreliability of land management arrangements, the more costly system is recommended.

TABLE 8 -1

UNIT PROCESS COST - SLUDGE HANDLING

		ANNUAL				PRESENT WORTH			
	Capital Cost	O & M 11 MGD	O & M 15 MGD	O & M Gradient	Salvage Value	Project Cost	O & M	Salvage Value	Total Present Worth
Aerobic Digester	537,000	40,700	55,500	740	232,700	698,100	530,500	71,200	1,157,400
Anaerobic Digester	958,000	15,600	21,200	280	415,100	1,245,400	203,000	126,900	1,320,500
Sludge Lagoon	145,000	39,000	46,000	350	113,100	188,500	477,500	34,600	631,400
Sand Drying Bed	723,000	121,000	131,300	515	288,700	939,900	1,432,200	88,300	2,283,800
Incineration	2,023,000	57,900	72,100	710	876,600	2,629,900	725,200	268,100	3,087,000
Centrifuge	838,000	96,300	120,000	1,185	363,100	1,089,400	1,206,500	111,000	2,184,900
Vacuum Filter	1,088,000	110,800	138,800	1,400	471,500	1,414,400	1,391,300	144,200	2,661,500
Thickener	246,000	27,400	37,400	500	106,600	319,800	357,300	32,600	644,500

SOURCE: Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities, U.S. E.P.A., Project #17090 DAN, October, 1971.

Process Design Manual for Sludge Treatment and Disposal, U.S. E.P.A. Technology Transfer, October, 1974.

Col. 4 O & M Gradient = $\frac{\text{Column 3 - Column 2}}{20}$

Col. 6 Project Cost = (Column 1) (1.3)
Col. 7 O & M = (Column 2) (11.47) + (Column 4) (86.01)
Col. 5 Salvage Value = (Column 6) (10/30)
Col. 8 Salvage Value = (Column 5) (0.3058)
Col. 9 Total Present Worth = Column 6 + Column 7 - Column 8

TABLE 8-2

ALTERNATIVE SLUDGE TREATMENT COST

Alternative	Unit Processes	Total Present Worth	Rank
1	Aerobic Digester Sludge Lagoon	$ 1,788,800	1
2	Aerobic Digester Vacuum Filter	$ 3,818,900	5
3	Thickener Vacuum Filter Incineration	$ 6,393,000	9
4	Aerobic Digester Centrifuge	$ 3,342,300	3
5	Thickener Aerobic Digester Sand Drying Bed	$ 4,085,700	7
6	Anaerobic Digester Sludge Lagoon	$ 1,951,900	2
7	Anaerobic Digester Vacuum Filter	$ 3,982,000	6
8	Anaerobic Digester Centrifuge	$ 3,505,400	4
9	Thickener Anaerobic Digester Sand Drying Bed	$ 4,488,000	8

NOTE: TOTAL PRESENT WORTH DOES NOT INCLUDE COST FOR SLUDGE DISPOSAL, i.e., LAND SPREADING, LANDFILL AND COMPOSTING TRANSPORTATION COST.

TABLE 8 -3

LAND DISPOSAL - HAULING COST

10% SOLIDS CONCENTRATON

PLANT SITE	Miles to Site	FT^3/ Day (1)	Tons/ Day (2)	Loads/ Day (3)	Ton-Miles/ Day	$/ Day (4)	$/ Year (5)	FT^3/ Day (1)	Tons Day (2)	Loads Day (3)	Ton-Miles Day	$/ Day (4)	$/ Year (5)
Winston Thomas	14.4	4675	147	8	2117	254.04	50,808	6800	214	11	3082	369.84	73,968
Dillman	12.3	4675	147	8	1808	216.96	43,392	6800	214	11	2632	315.84	63,168
Ketcham	11.6	4675	147	8	1705	204.60	40,920	6800	214	11	2482	297.84	59,568
Salt Creek	8.7	4675	147	8	1279	153.48	30,696	6800	214	11	1862	223.44	44,688

NOTES:
(1) Sludge Hauled 200 Days/Year
(2) 1700 #/YD^3
(3) 20 Tons/Load Limit
(4) $.12/Ton-Mile
(5) 200 Days/Year

PRESENT WORTH

Winston Thomas	682,400
Dillman	582,800
Ketcham	549,600
Salt Creek	412,300

20% SOLIDS CONCENTRATION

PLANT SITE	Miles to Site	FT^3/ Day (1)	Tons/ Day (2)	Loads/ Day (3)	Ton-Miles/ Day	$/ Day (4)	$/ Year (5)	FT^3/ Day (1)	Tons Day (2)	Loads Day (3)	Ton-Miles Day	$/ Day (4)	$/ Year (5)
Winston Thomas	14.4	2345	74	4	1066	127.92	25,584	3410	107	6	1541	184.92	36,984
Dillman	12.3	2345	74	4	910	109.20	21,840	3410	107	6	1316	157.92	31,584
Ketcham	11.6	2345	74	4	858	102.96	20,592	3410	107	6	1241	148.92	29,784
Salt Creek	8.7	2344	74	4	644	77.28	15,456	3410	107	6	931	111.72	22,344

PRESENT WORTH

Winston Thomas	342,500
Dillman	292,400
Ketcham	276,000
Salt Creek	207,000

TABLE 8-4

COMPOSTING - HAULING COST

20% SOLIDS CONCENTRATON

PLANT SITE	Miles to Site	FT^3/ Day	Tons Day	Loads/ Day	Ton-Miles Day	$/ Day	$/ Year	FT^3/ Day	Tons Day	Loads Day	Ton-Miles Day	$/ Day	$/ Year
Winston Thomas	6.8	2345	74	4	503	60.36	12,072	3410	107	6	728	87.36	17,472
Dillman	6.6	2345	74	4	488	58.56	11,712	3410	107	6	706	84.72	16,944
Ketcham	9.5	2345	74	4	703	84.36	16,872	3410	107	6	1017	122.04	24,408
Salt Creek	14.7	2345	74	4	1088	130.56	26,112	3410	107	6	1573	188.76	37,752

PRESENT WORTH

Winston Thomas	161,700
Dillman	156,900
Ketcham	226,000
Salt Creek	349,600

TABLE 8-5

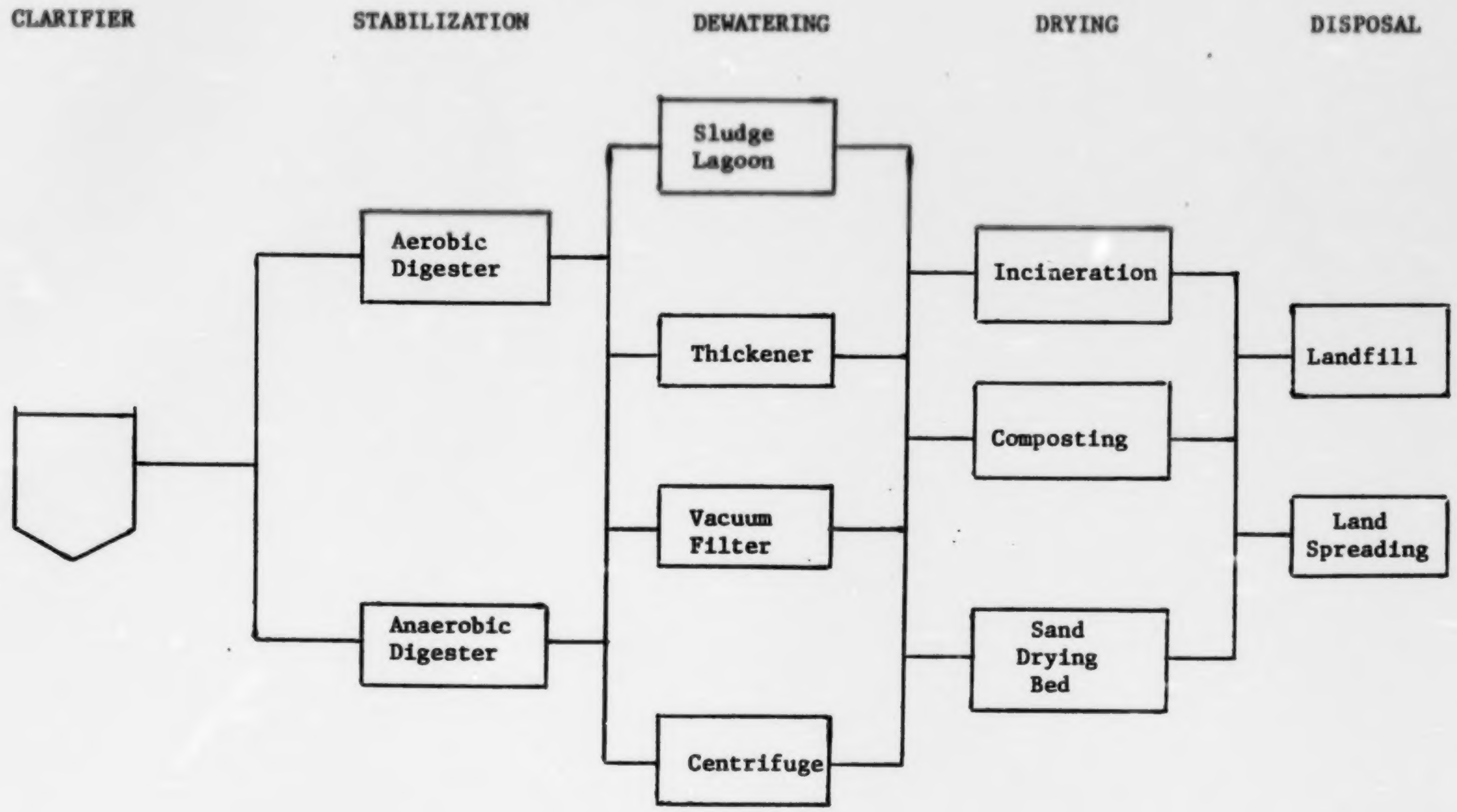
SUMMARY OF SLUDGE TREATMENT AND DISPOSAL COST

Plant Site	Sludge Treatment Alternative	Present Worth	Sludge Disposal Alternative	Present Worth	Total Present Worth
Winston Thomas	Aerobic Digester - Lagoon	$1,788,800	Soil Injection	$1,418,700	$3,207,500
	Aerobic Digester - Centrifuge	3,342,300	Surface Spreading	1,076,700	4,419,000*
	Aerobic Digester - Centrifuge	3,342,300	Composting	161,700	3,504,000
Dillman	Aerobic Digester - Lagoon	1,788,800	Soil Injection	1,319,100	3,107,900
	Aerobic Digester - Centrifuge	3,342,300	Surface Spreading	1,026,600	4,368,900*
	Aerobic Digester - Centrifuge	3,342,300	Composting	156,900	3,499,200
Ketcham	Aerobic Digester - Lagoon	1,788,800	Soil Injection	1,285,900	3,074,700
	Aerobic Digester - Centrifuge	3,342,300	Surface Spreading	1,010,200	4,352,500*
	Aerobic Digester - Centrifuge	3,342,300	Composting	226,000	3,568,300
Salt Creek	Aerobic Digester - Lagoon	1,788,800	Soil Injection	1,148,600	2,937,400*
	Aerobic Digester - Centrifuge	3,342,300	Surface Spreading	941,200	4,283,500
	Aerobic Digester - Centrifuge	3,342,300	Composting	349,600	3,691,900
	Aerobic Digester	1,153,400	20 Year Lagoon w/Liner	2,975,400	4,132,800
	Aerobic Digester	1,157,400	20 Year Lagoon w/o Liner	1,781,500	2,938,900

* Recommended method for site.

FIGURE 8 -1

SLUDGE TREATMENT AND DISPOSAL PROCESSES


CLARIFIER
STABILIZATION
DEWATERING
DRYING
DISPOSAL
Aerobic Digester
Anaerobic Digester
Sludge Lagoon
Thickener
Vacuum Filter
Centrifuge
Incineration
Composting
Sand Drying Bed
Landfill
Land Spreading

CHAPTER 4
ENVIRONMENTAL EFFECTS OF ALTERNATIVES

TASK 9

PHYSICAL ENVIRONMENTAL IMPACTS

9.1 IMPACT ON THE ECOLOGY

9.1.1 General

The ecosystem of the area will be adversely impacted during construction and operation of the proposed wastewater treatment plant only if the mitigative measures recommended in Task 11 are not practiced. It is recommended that a member of the Bloomington Utility Board make frequent inspections during construction operations to ensure that the recommended mitigative measures are implemented.

The caliber of adverse physical environmental impacts which can result from poor engineering practices and which should be avoided in the proposed project are described in an article appearing on page 3 of the July 1969 Bloomington Newspaper, "The Balancer," which reports sewer lines, siphon boxes and manholes constructed in the Bean Blossom Flood Plain were not buried and covered properly. As a consequence, during heavy rains the pipe lines dammed up water which became stagnant and served as a hatching area for mosquitos. The pipelines were uncovered and heavy siltation of the creek occurred below the facilities.

In the following paragraphs, the possible sources of physical damage to the aquatic and terrestrial environments due to construction and operation activities will be considered. Table 9-1 compares the physical impacts by alternative sites for the wastewater treatment plant.

9.1.2 Aquatic Ecology

Rare and Endangered Aquatic Organisms

No aquatic organisms appearing in the area of the proposed project are considered rare or endangered as defined in The Federal Register (July 1, 1975) and the U.S. Department of Interior (1974). Table 9-2 lists the aquatic organisms which have been found in the subject area.

Impacts of Interceptors and Outfalls on the Aquatic Environment Storm water runoff carrying silt from areas excavated for interceptors, outfalls and other facilities associated with the project could affect the biota of Clear and Salt Creeks. The smothering influence of silt could affect the primary producers as well as all other levels of the food chain. Filter-feeding zooplankton are harmed because their feeding apparatus becomes clogged. Aquatic plants are affected because silt suspended in the water blocks out light and inhibits photosynthesis. Dying plants consume oxygen and lower dissolved oxygen (DO) of the water. A decrease in DO could be harmful to fish when they are smothered as a result of silt particles clogging their operculum cavity and gill filaments. Silt settling on fish eggs decreases oxygenation of the eggs, which die. This effect on fish populations is the most severe effect of silt production.

Because the depth of soil over the bedrock is much greater in the alluvial portion of Clear Creek near its confluence with Salt Creek, the quantity of silt in runoff is greater there than in the upper portions of the creek. This situation contrasts to the waters of Clear Creek further north where topsoil is not as thick and runoff is not as silt-laden. Observation made of the creek in August of 1975 confirmed that near the confluence of Salt and Clear Creeks the water was very muddy. Between Bloomington and Ketcham road, Clear Creek was relatively clear. Heavy siltation of the creek during construction activities would worsen the already bad siltation problem in the southern end of Clear Creek and create a new and adverse condition if it occurred in the northern reaches of the creek. Silt production can be minimized if the recommended engineering practices mentioned in Task 11 are followed.

Crossing of the creek with interceptor lines and rerouting the creek are construction activities which are potential sources for alterations in the natural aquatic ecology of the area if good engineering practices are not followed. Because the creek bed is solid limestone the dredging and blasting required for these activities is not expected to produce a great deal of silt. While the trench is being dug, habitats for benthic organisms in the immediate area will be disrupted; however, after the encased pipeline is installed the trench will be refilled with riprap consisting of the caliber of heavy stones which now line the creek bed. These stones will be recolonized by organisms seeded from the water passing over them.

Proof of the ability for Clear Creek to recover from localized devastation is shown by two historical occurrences:

1. The installation of the tertiary lagoon in the Winston Thomas Sewage Treatment Plant

2. Rerouting the creek to accomodate expansion of the Winston Thomas Sewage Treatment Plant

Prior to 1969, when the tertiary lagoon was built, the poor water quality of the creek was reflected in the low species diversity for invertebrates and absence of fish. Since the lagoon has been installed and the quality of sewage effluent flowing into the creek has improved, species diversity of invertebrates has increased and the more tolerant Cyprinidae such as the stoneroller (*Campostoma anomalum*) and the creek chub (*Semotilus atromaculatus*) have been found near the outfall (D.G. Frey - personal communication).

When the creek was rerouted, the water channel was simply transferred from one bedrock channel to a new one with no apparent disruptions of the creek south of the rerouting.

Impacts of Operation on the Aquatic Ecology - Effluent

The physical effects of the effluent will depend on where the outfall is located and the degree to which the sewage is treated. According to Indiana State regulations, the following levels of treatment will be required by 1977 for discharges to Salt Creek and Clear Creek.

	Salt Creek	Clear Creek
BOD (Biological Oxygen Demand)	10 mg/l or 95% removal	5 mg/l or 97.5% removal
Suspended Solids	10 mg/l or 95% removal	5 mg/l or 97.5% removal
Phosphorus	1 mg/l or 80% removal	1 mg/l or 80% removal
Ammonia Nitrogen	6.5 mg/l in summer no limitation in winter	1.5 mg/l summer 3.0 in winter

The requirements for a greater degree of treatment for effluent discharged into Clear Creek is due to the lower dilution rate which occurs there. When comparing the potential physical effects of the effluent discharged into Clear Creek and Salt Creek, the two primary considerations are:

1. The decreased flow which would occur in Clear Creek if the effluent were no longer discharged into it

2. The chemical characteristics of the effluent when it reaches a water intake for the city of Bedford, 13 miles downstream from the Lake Monroe dam

Canoeing of Clear Creek is impossible during low flow conditions which normally occur during the summer. On four sampling dates between February 22, 1975 and April 2, 1975 (a high flow period for the creek) the flow of Clear Creek averaged 200 MGD (Pullman G. Douglas, 1975).

If the flow from the city's sewage treatment plant was removed from Clear Creek and discharged into Salt Creek, Clear Creek would be unnavigable by canoe sooner than it is now. If the outfall is moved farther south on Clear Creek, the flow from Bloomington to the new location will be reduced from its present level. This reduced flow rate which could occur if effluent were removed from Clear Creek is significant from another standpoint: it would no longer dilute the pollutants which drain into the creek from a variety of sources. Hartzel et al. (1971) reported that pollution of Clear Creek above the Winston Thomas Sewage Treatment Plant outfall came from the following sources:

1. Oil from a creosote plant
2. Indiana University via the Jordan River which is located on campus
3. Faulty septic tank drainage fields
4. Runoff from Bloomington

On April 2, 1971, water quality parameters which were more severe above the sewage treatment plant when compared to those below it included:

1. Bicarbonate alkalinity
2. pH
3. Nitrate
4. Resistivity

These parameters were improved below the outfall due to the effect of dilution. Parameters which were more severe below the plant included dissolved oxygen, calcium, and total phosphate. Removing the effluent from Clear Creek or upgrading the treatment to the projected level required for 1977 would generally improve the water quality of Clear Creek. However, those pollutants which enter from above the point of discharge of the Winston Thomas plant would no longer be diluted and their concentrations would become higher than they are now below the discharge of the Winston Thomas Plant.

Two questions have been raised concerning the effect sewage will have on the City of Bedford's water intake on Salt Creek. The first is whether the effluents could raise the nitrage level in the water to a level which would be toxic to humans drinking it. The nitrate concentrations above and below the present Winston Thomas Treatment Plant on April 2, 1971, were 5.6 above the discharge and 2.0 ppm below the discharge, and 3.9 and 6.6 ppm on April 9. On April 12, 1975 at 7 P.M., the nitrate concentration was 3.2 ppm at Clear Creek, 0.29 ppm on Salt Creek and 0.3 ppm at their confluence. These were high flow conditions. During low flow conditions, the nitrate levels may be considerably higher. In addition to the effluent, another source of nitrate is the sludge injected into the land, which could be washed off during floods. This is a potential problem only at the Salt Creek site where the sludge injection system is proposed and where frequent flooding occurs. The amount of nitrate which could be washed off during floods can be controlled through manipulation of the application rates. As discussed in Section 11.2.1, it is recommended that if the Salt Creek site is selected, a study be carried out to determine the application rates. Pollution of surface or ground water with other materials as a result of the sludge injection system would not be expected (Ken Dotson EPA, Cincinnati, personal communication). After the effluent is discharged into a creek, the nitrate concentration will drop as a consequence of denitrification and nitrate reduction which occurs naturally as the creek flows southward. There is no possibility that the nitrate concentration could reach the 50 ppm level which has been associated with infant methemaglobinemia (Maxey-Rosenau, 1965).

There has also been some question about toxic chlorinated organics in the effluent reaching the intake for the City of Bedford's water supply. The chlorinated organics form as a result of the chemical reaction of chlorine, added to the sewage for disinfection purposes, and the organics discharged into the sewage by industries and university laboratories. No definite statement can be made at this time concerning this potential problem except that natural degradation of the compounds is more likely to occur in Clear Creek which is well aerated and further from the reservoir than will occur in Salt Creek which is less aerated and closer to the intake. In addition, the greater degree of treatment required for sewage discharged into Clear Creek may result in the decomposition of the organics which could react with chlorine and will decrease the quantity of chlorine required for disinfection. It is recommended that the raw sewage and chlorinated effluent from the Winston Thomas Sewage Treatment Plant be analyzed by the gas chromatographic mass spectro-photometric method to identify toxic chlorinated compounds that may be formed during the chlorination process. If they are detected, alternative disinfection systems can be designed into the proposed treatment plant. Alternatives which could be considered include:

1. Ozonation
2. Chlorination - dechlorination
3. Bromine chloride
4. No disinfection

*"... uncontrolled and excessive use of chlorine for wastewater disinfection may result in potential harm to both human and aquatic life (A/WPR, April 28, 1975, p. 166) ...Alternative means of disinfection control (dechlorination) must be considered where public health hazards and potential adverse impact on the aquatic and humand environments coexist, but disinfecting should not be required in those instances where benefits are not present." (A/WPR, August 25, 1975, p. 332).

9.1.3 Terrestrial Ecology

Rare and Endangered Terrestrial Organisms

A search of the scientific and other literature was conducted to determine if rare or officially designated "endangered" species might occur in the area. Table 8-3 lists terrestrial vertebrates of potential occurrence which are listed as "threatened" and/or "endangered" by the U.S. Department of the Interior, Office of Endangered Species and International Activities (1973, 1974). Because critical nesting habitat for the two birds is absent from the area, and caves which would attract the bat (Hall 1962) are unknown in the areas potentially affected, it is believed that effects of construction would be neglible at any site proposed.

Impact of Interceptors and Outfalls on Terrestrial Ecology

Interceptor and connector sewers necessary for the several alternatives under study would require trenches of depth and width appropriate to provide drainage by gravity. If the Salt Creek site is chosen, it will require interceptors. The interceptors will require trenches about 2m (6 feet) wide, no less than 2.7 m (9 feet) deep, and extending for varying lengths, but in no instance less than several kilometers.

One hundred foot construction right-of-ways and 50 foot permanent right-of-ways are required for interceptors. After the trench was closed, vegetation could become reestablished along the right-of-way, and in fact would be essential to prevent damage from erosion and to limit penetration of frost.

It would be necessary to maintain a road for vehicles along the entire length of the right-of-way to permit inspection and repair to the facility. Manholes would protrude at intervals. Consequently, construction of any sewer so large as the several proposed in alternative plans in the present project must be assumed to have significant effect, much of which will not diminish for the useful life of the sewer, and much lasting long after the sewer line has lost its utility. The following paragraphs discuss in some detail the effects probable from constructing such sewers.

The effects of clearing a wide swath through fields and woodlands, or along the riparian vegetation bordering such a stream as Clear Creek, are manifestly significant, whether or not they can be quantified in a particular instance. Vegetation would be destroyed. Consequently, the area would become untenable, at least during construction, for many kinds of animals dependent on that vegetation. Any such project as those considered here clearly has unavoidable influence on vast areas. For example, a right-of-way only 100 feet wide would occupy about 12 acres per mile (i.e., a right-of-way 30 m wide and 1.6 km long would occupy 4.9 ha).

If the interceptor is built to the Salt Creek site, it should clearly affect riparian communities to the almost total exclusion of uplands, and the right-of-way would traverse cropland at almost every point where it was not in woods.

The riparian vegetation which would be removed by construction is suitable habitat for a variety of game species of recreational importance, as well as some species which are apparently incompletely harvested (e.g., raccoons, _Procyon lotor_). More hunter pressure is apparently placed on upland game birds (e.e., ring-necked pheasants, _Phasianus colchicus_) in the adjacent croplands, and destruction of forest growth would probably increase the attractiveness of the area traversed by the sewer to hunters during a brief part of the year.

Clear Creek is a moderately severely polluted stream, presently ill-suited for most aquatic sports for much of its length. However, it is presently used during the period of high water in the winter for canoeing; it has been characterized as the "only" sizable reach of water suitable for canoeing in a radius of 30 miles or more from Bloomintgon. The riparian growth, while difficult to traverse on foot, offers a potentially rewarding experience to hikers along the stream. The Cedar Cliffs preserve, owned by the Nature Conservancy, is in fact worthy of protection as a wild area; and it is recommended strongly that no construction be considered which would degrade the area.

The presently proposed sewer routing, and any other along Clear Creek that seems to be economically feasible, would have little adverse effect on agriculture. Digested sludge probably would be a beneficial soil adjuvant in the area, and consequently its availability would encourage agricultural use of bottom lands.

The importance of forest industries in the region appears to be small at present, though some large and consequently merchantable trees have been noted in the riparian community. However, the destruction of timber associated with construction of the proposed sewer would be deleterious in proportion to its extensiveness.

The use of Clear Creek for recreational purposes might be fostered if adequate sewage treatment were to be instituted to ensure its attractiveness throughout the year. Use of the creek for aquatic sports, including fishing, might well induce the construction of summer homes or year-round residences along its course. Such use would probably depend upon the availability of convenient sewer connections.

Information on potential industrial development which might be encouranged by constructing the sewer is not known.

Man can influence succession in many ways. Some of these involve the establishment of almost permanent disclimaxes. Egler and Foote (1975) provide a book-length summary of techniques for stabilizing the vegetation of rights-of-way, and review the scientific literature.

One economically advantageous course of management of the right-of-way would provide for establishing shrubs along the boundaries of the affected area and limiting growth in the center to grasses and other herbaceous vegetation too low to interfere with the passage of off-road vehicles. Experience elsewhere suggests that such self-sustaining plant communities could be established in this area by making appropraite plantings initially. However, experiments have not to our knowledge yet been performed which would definitively demonstrate the feasibility of such techniques, and it may be necessary to limit growth in part by mechanical and/or chemical means.

However, if vegetation on rights-of-way is maintained, we assume here that a stable plant community can in fact be established, and that the growth-form of the plants will be various, ranging from grasses and low shrubs to tall trees. The habitats afforded by such a community will be more productive of game and other animals than if a sharp delimintation of forest from an artifically-maintained grassland type existed, because of the phenomenon of edge effect (Leopold 1933:131-132, Ghiselin 1975).

9.2 Impact on the Visual Aesthetics

While the design of the plant and the arrangements may differ slightly from site to site, the visual impact of the plant site will depend largely upon its position, wihin the landscape with respect to both terrain and natural vegetation, as well as upon the number and position of potential viewers, and the duration or frequency of the view. Since each sense is not entirely independent of each other, the odor associated with a plant might easily influence the visual register of the plant.

Of all the potential sites, only one, the existing Winston Thomas Site is located within an existing or planned development corridor. One might theorize that this plant has been there for such a long time that the average person wouldn't even be visually bothered by a different plant site configuration. Nonetheless, it is here where trailers, residences, and apartments are located in relatively close proximity on the hills overlooking the site to the west of Clear Creek. A good part of the view from this residential development along Rogers Road is visually screened from the site by the natural tree line found between the residences and along the railroad and Clear Creek. In addition, views are possible from the Gordon Road trailer development as well as from traffic passing along Old State Route 37, the main north-south artery.

Both the Salt Creek and the Dillman Plant Sites would be visible from State Route 37 Bypass, the Dillman Site for a shorter duration than the Salt Creek Site. The latter is, however, more distant from the viewer, in this case from a vehicle, than would be the Dillman Site. The Dillman Site is, however, tucked into a narrow landform depression at a point where the highway alignment changes quickly and, therefore, probably eliminating any long duration vistas toward the site, which might be more prevalent at the Salt Creek Site.

The Ketcham Site is the most visually removed of all the sites. Both Dillman and Salt Creek are located well outside the limits of planned growth corridors, so they shouldn't be surrounded by development which might intensify their future visual impact. The Salt Creek site does, however, sit adjacent to the boundary of a potential seasonal development which would overlook the site.

9.3 Impact on the Traffic Pattern

Traffic impacts are expected to be minimum with peak truck traffic expected during sludge removal. Most of the plant sites are located relatively close to major arteries; with Dillman, Ketcham, and Salt Creek having access via State Route 37 Bypass; and Winston Thomas and Rogers via Old State Road 37. In this regard, the impact will be relatively more significant in the more urbanized locations, however, all of these major highways have significant traffic capacity to add a few more trucks, approximately fifteen round trips per day.

The Dillman Site cannot be reached without a new bridge over Clear Creek since the present bridge is one lane wide and limited to five tons. Construction truck traffic, especially cement trucks, would have trouble getting to this site unless a new bridge were to be constructed. The fact that a new bridge would be constructed here as part of the creek relocation would result in a positive impact.

The Ketcham Road Site probably has the most inadequate and hazardous highway access of all the sites. Not only is Ketcham Road narrow, but its intersections with State Route 37 and Fluckmill Road are hazardous. In addition, the railroad underpass may be too low to allow for construction truck traffic to pass under it. The only other access way to this site is via Victor Road, a narrow, curving, rural residential road.

The Salt Creek site offers few, if any, potential traffic impacts.

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TABLE 9-1

MAJOR PHYSICAL IMPACTS OF PROJECT AT ALTERNATIVE SITES - A COMPARISON

Alternative Site	Rerouting Clear Creek Required?	No. Encased Steam Crossings Required	No. Railroad Crossing Tunnels Required	Distance From Discharge To Bedford Water Intake on Salt Creek (Potential for Natural Treatment of Discharged Effluent Before Bedford Intake)	Feet of Clear Creek With Reduced Flow	Amount of Soil Over Bedrock - (Potential for Silt Production During Construction)	% Ground Slope (Potential for Silt Production During Construction)
Winston Thomas	Yes	0	0	23 mi.	0	5	Unknown
South Rogers	Yes	0	0	23 mi.	0	5	Unknown
Dillman Road	Yes	3	3	20 mi.	10,500 ft.	5	6 to 12%
Ketcham	Yes	8	7	19 mi.	14,000 ft.	7	2 to 12%
Salt Creek	Yes	25	15	13 mi.	55,500 ft.	10	0 to 75%

TABLE 9-2

AQUATIC ORGANISMS FOUND IN LAKE MONROE AND EXPECTED IN SALT CREEK[1]

Fish

Largemouth bass	*Micropterus salmoides*
Bluegill	*Lepomis macrochirus*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Yellow perch	*Perca flavescens*
Yellow bass	*Morone mississippiensis*
Carp	*Cyprinus carpio*
Black bullhead	*Ictalurus melas*
Yellow bullhead	*Ictalurus natalis*
Channel catfish	*Ictalurus punctatus*
White sucker	*Catostomus commersoni*
Spotted sucker	*Minytrema melanops*
Redear sunfish	*Lepomis microlophus*
Pumpkinseed	*Lepomis gibbosus*
Longear sunfish	*Lepomis megalotis*
Green sunfish	*Lepomis syanellus*
Warmouth	*Lepomis gulosus*
Orange-spotted sunfish	*Lepomis humilis*
Redhorse	*Moxostoma* sp.
Rockbass	*Ambloplites rupestris*
Smallmouth bass	*Micropterus dolomieui*
Flathead catfish	*Pylodictis olivaris*
Northern pike	*Esox lucius*

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[1] From Gray et al 1975

TABLE 9-2 (Continued)

Nannoplankton Algae and Protozoa

Melosira italica
Melosira sp.

Dinobryon divergens
Dinobryon bavaricum

Stephanodiscus sp.

Merismopedia tenuissima
Merismopedia minor

Ankistrodesmus sp.

Cryptomonas sp.

Fragilaria crotonensis

Chroococcus limenticus
Chroococcus minor

Mallomonas akrokomas
Mallomonas sp.

Coelastrum sp.

Asterionella formosa

Anabaena lemmermanni

Coelosphaerium kutzingianum

Strombidium viride

TABLE 9-2 (Continued)

Zooplankton

- Protozoa
    - *Codonella*
    - *Ceratium*
    - *Difflugia cristata*
    - *peritrich*

- Rotifera
    - *Ascomorpha*
    - *Asplanchna*
    - *Branchionus*
    - *Colurella*
    - *Conochilus*
    - *Filinia*
    - *Gastropus*
    - *Kellicottia*
    - *Keratella cochlearis*
    - *Polyarthra euryptera*
    - *Polyarthra vulgaris*
    - *Rotatoria*
    - *Trichocerca*

- Cladocera
    - *Alona* sp.
    - *Alonella* sp.
    - *Bosmina coregoni*
    - *Ceriodaphnia lacustris*
    - *Chydorus spaericus*
    - *Daphnia laevis*
    - *Daphnia retrocurva*
    - *Diaphanosoma leuchtenbirgeanum*
    - *Holopedium gibberum*
    - *Leptodora kindtii*
    - *Pleuroxus denticulatus*
    - *Pseudosida bidentata*
    - *Sida crystallina*

- Copepoda
    - *Cyclops* (2 sp.)
    - *Limnocalanus*
    - *Diaptomus*

- Ostracoda

TABLE 9-2 (Continued)

Phytoplankton

1. Cyanophyceae
    - Chroococcales
        - *Chroococcus*
        - *Coelospaerium*
        - *Dactylococcopsis*
        - *Gloeocapsa*
        - *Gomphosphaeria*
        - *Marssoniella*
        - *Merismopedia*
        - *Microcystis*
    - Chaemaesiphonales
        - *Pleurocapsa*
    - Oscillatoriales
        - *Anabaena*
        - *Lyngbya*
        - *Oscillatoria*
2. Chlorophyceae
    - Chloroccoccales
        - *Ankistrodesmus*
        - *Crucigenia*
        - *Lauterborniella*
        - *Oocystis*
        - *Pediastrum*
        - *Scenedesmus*
        - *Tetraedron*
    - Tetrasporales
        - *Gloeocystis*
    - Volvocales
        - *Volvox*
    - Zygnematales
        - *Closterium*
        - *Cosmarium*
        - *Gonatozygon*
        - *Micrasterias*
        - *Spirogyra*
        - *Staurastrum*
3. Chrysophyccae
    - *Dinobryon*
    - *Mallomonas*
    - *Ochromonas*
4. Xanthophyceae
    - *Asterogloea*
    - *Ophiccytium*
5. Bacillariophyceae
    - Centrales
        - *Cyclotella*
        - *Melosira*
        - *Stephanodiscus*
        - *Terpisnoe*
    - Pennales
        - *Amphiprora*
        - *Amphora*
        - *Asterionella*
        - *Cymbella*
        - *Fragilaria*
        - *Gyrosigma*
        - *Navicula*
        - *Neidium*
        - *Nitzschia*
        - *Surirella*
        - *Synedra*
        - *Tabellaria*

TABLE 9-2 (Continued)

Aquatic Organisms Found in Clear Creek[1]

- Monera
    - *Sphaerotilus*
- Algae
    - Chlorophyta (green algae)
        - Volvocales
            - *Chlamydomonas*
        - Tetrasporales
            - *Tetraspora*
        - Ulotrichales
            - *Ulothrix*
            - *Stigeoclonium*
            - *Chaetophora*
            - *Coleochaete*
        - Cladophorales
            - *Cladophora*
        - Oedogoniales
            - *Oedogonium*
        - Zygnematales
            - *Zygnema*
            - *Spirogyra*
        - Chlorococcales
            - *Ankistrodesmus*
        - Desmidiales
            - *Closterium*
            - *Cosmarium*
    - Euglenophyta (euglenoids)
        - Euglenales
            - *Euglena*
            - *Peranema*
    - Chrysophyta (yellow-green algae & diatoms)
        - Chrysomonadales
            - *Synura*
        - Pennales
            - *Tabellaria*
            - *Diatomella*
            - *Meridion*
            - *Diatoma*
            - *Fragilaria*
            - *Synedra*
            - *Asterionella*
            - *Ceratoneis*

TABLE 9-2 (Continued)

    - *Cocconeis*
    - *Brebissonia*
    - *Gyrosigmia*
    - *Anomoeneis*
    - *Amphipleura*
    - *Navicula*
    - *Cymbella*
    - *Amphora*
    - *Gomphonema*
    - *Gomphoeneis*
    - *Aphanotheca*
    - *Nitzschia*
    - *Bacillaria*
    - *Denticula*
    - *Centronella*
  - Cyanophyta (blue-green algae)
    - *Anacystis*
    - *Oscillatoria*
    - *Lyngbya*
    - *Spirulina*

- Vascular Plants
  - Najadaceae (pondweed)
    - *Potomogeton*

- Protozoa
  - Sarcodina
    - *Amoeba*
  - Ciliata
    - *Vorticella*

- Coelenterata
  - Hydrozoa
    - *Hydra*

- Platyhelminthes (flatworms)
  - Turbellaria
    - *Dugesia*

- Aschelminthes
  - Nematoda
  - Rotifera

TABLE 9-2 (Continued)

- Tardigrada

- Annelida
  - Oligochaeta
    - *Aeolosoma*
    - *Tubifex*
    - *Lumbricus terrestris*
  - Hirudinea
  - Glossophonidae
  - Piscicolidae
    - *Pisicola*

- Mollusca
  - Gastropoda (snails)
    - *Lymnaea*
    - *Goniobasis*
    - *Campeloma*
    - *Physa*
    - *Helisoma*
  - Pelecypoda (bi-valves)
    - *Sphaerium*
    - *Musculium*

- Arthropoda
  - Chelicerata
    - Arachnida

- Arthropoda
  - Crustacea
    - Malacostraca
      - Isopoda
        - *Asellus*
        - *Lirceus*
      - Amphipoda
        - *Gammarus*
        - Haustoriidae
      - Decapoda
        - *Cambarus laevis*
        - *C. d. diogenes*
        - *Orconectes p. propinquus*
  - Insecta
    - Apterygota
      - Collembola (springtails)

TABLE 9-2 (Continued)

- Pterygota
  - Ephemeroptera (mayflies)
  - Ephemeridae
    - *Hexagenia*
  - Heptageniidae
    - *Stenonema*
  - Baetidae
    - *Neocloeon*
  - Odonata (dragonflies)
    - *Anisoptera*
    - *Aeschnidae*
    - *Gomphidae*
  - Zygoptera
    - Agrionidae
      - *Nehallenia*
  - Plecoptera (stoneflies)
    - Perlidae
      - *Atoperla*
    - Isoperlidae
      - *Isoperla*
  - Hemiptera (true bugs)
    - Corixidae
    - Notonectidae
    - Gerridae
  - Neuroptera
    - Corydalidae
      - *Corydalus*
  - Coleoptera (beetles)
    - Elmidae
      - *Stenelmis*
    - Haliplidae
      - *Peltodytes*
    - Hydrophilidae
    - Psephenidae
      - *Psephenus*
  - Trichoptera (caddisflies)
    - Rhyacophilidae
      - *Hesperophyla*
    - Hydropsychidae
      - *Drydropsyche*
    - Hydrophilidae
    - Limnephilidae

TABLE 9 -2 (Continued)

- Diptera (flies)
  - Tipulidae
  - Chironomidae
    - *Chironomus*
  - Tipulidae
    - *Hexatoma*
  - Simulidae
  - Culicidae
    - *Culex*

- Chordata
- Osteichthyes
  - Cyprinidae (carps & minnows)
    - *Campostoma anomalum*
    - *Pimephales notatus*
    - *Semotilus atromaculatus*
    - *Ericymba buccata*
  - Centrarchidae (sunfish)
    - *Lepomis cyanellus*
  - Percidae (perch)
    - *Etheostoma spectabile*
    - *E. flabellare*
    - *E. nigrum*
- Amphibia
  - Urodela (salamanders)
    - Plethodontidae
  - Anura (frogs & toads)
    - *Rana catesbeiana*

  - Reptilia
    - Squamata (lizards & snakes)
      - *Natrix s. sipedon*

TABLE 9-3

TREES OF THE RIVER BOTTOMS

Common Name	Scientific Name
Black walnut	*Juglans nigra*
American hornbeam	*Carpinus caroliniana*
Oak	*Quercus* sp.
Chestnut oak	*Quercus prinus*
Elm	*Ulmus* sp.
Hackberry	*Celtis* sp.
Sassafras	*Sassafras albidum*
Sycamore	*Platanus occidentalis*
Wild black cherry	*Prunus serotina*
Water locust	*Gleditsia aquatica*
Silver maple	*Acer saccharinum*
Basswood	*Tilia americana*
Ash	*Fraxinus* sp.

RARE AND ENDANGERED TERRESTRIAL VERTEBRATES POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Remarks
Peregrine falcon	*Falco peregrinus* sspp.	Possibly transient
Kirtland's warbler	*Dendroica kirtlandii*	Possibly transient
Indiana bat	*Myotis sodalis*	Possibly summer resident

TABLE 9-3 (Continued)

HERBS AND SHRUBS OF THE RIVER BOTTOMS

Common Name	Scientific Name
True Solomon's seal	Polygonatum commutatum
Hydrangea	Hydrangea sp.
Wood-sorrel	Oxalis sp.
Poison ivy	Rhus radicans
Jewel weed	Impatiens sp.
Black-eyed Susan	Rudbeckia hirta
Ironweed	Vernonia sp.

TASK 10

INDUCED DEVELOPMENT - LAKE MONROE

10.1 INTRODUCTION

10.1.1 Regionalization Issue

The issue of induced development and its secondary impacts on Lake Monroe assumes the eventual development of sewerage service. The issue of how this service will emerge or develop and what form it will take is also the issue within the regionalization issue. Without a regional interceptor around the lake and a near term demand of 3.0 MGD, there would really be little need to locate a plant sized to serve the Bloomington Region at the lake.

Both the Bloomington and the Lake Monroe Regional Waste District 201 Plans assumed that the Lake Regional System and single regional treatment at Salt Creek was the best alternative. The reaction following this conclusion was that widespread environmental damage would result from the increased development at the lake.

10.1.2 Other Questions and Considerations

The Consultant, based upon independent analysis and many unanswered questions about the market potential, timing, and other factors, has found it extremely difficult to theorize induced impacts at Lake Monroe. There are no real assurances that many of these proposed or potential developments around the lake are actually viable undertakings. On this basis, the economic feasibility of the regional sewer system for the lake is questionable, as is the matter of how such a system could somehow be constructed so as to logically and sequentially serve development proposals as they fall due. It is also difficult to corroborate the Lake Monroe Regional Waste District rationale for near term sewerage service in light of the lack of firm commitments.

Also worthy of consideration is the possibility that sewer development itself may well not be the overriding consideration on whether the Lake Monroe area grows or not. In fact, considerations of the market for second homes, the money market, and potential income tax reform might override the sewer question.

One thing that is obvious is that the nature of the regional system as proposed benefits the large scale developer who can afford the interim treatment facilities needed, costs of pumping and injecting into the force main, and what is anticipated to be a rather expensive system to operate.

There are enough other uncertainties attached to expectations for development around the lake to further cloud the issue, the main one being the fact that the State of Indiana is the biggest and most successful developer around the lake.

Further complicating this analysis is the lack of readily available data, the multiplicity of public and private interests which are often times strongly intertwined, and the lack of any overall coordinated water and land use goals and policies.

The potential growth of the lake area will for the most part depend on future expectations in seasonal and recreational housing. Trends within the latter market are probably far more significant with respect to inducing development than the construction of a regional sewer system around Lake Monroe. Conversely, without the market, there will in all probability be no demand for such a sewer system.

Present knowledge of the potential market for seasonal and recreational development at Lake Monroe is indeed limited, even as limited as current information regarding the multitude of lake side private projects talked about, but never evidently entering the planning and scheduling stages. Balanced against the total market considerations must certainly be the physical, chemical, and recreational carrying capacity of the lake itself, and the watershed draining into it. Hopefully, the ongoing land capability plan will better address some of these issues.

There are a multitude of federal and state agencies in a position to influence the development in and around the lake either directly or indirectly. These include the U.S. Forest Service, the U.S. Army Corps of Engineers, the Farmers Home Administration, and EPA at the federal level. At the state level, the Department of Natural Resources and Department of Health are in a position to influence land development potential. At the local level, the Lake Monroe Regional Waste District and the Monroe County Planning Commission are in a position to directly influence the rate and direction of growth.

10 .2 THE UNIQUE ROLE OF THE STATE OF INDIANA

The State of Indiana, through its Natural Resources Department, occupies a very special and privileged role in the real estate aspects of Lake Monroe development. The State indirectly influences lake recreational usage by controlling public access points to the lake and lakeside facilities, since they are the only lakeside developer having direct access to the lake from the shoreline other than the U.S. Army Corps of Engineers.

This consideration means that the State may be in a position to influence development and change within the Lake Monroe watershed to an even greater degree than some of the proposed seasonal developments, particularly when one investigates the complete lack of a definitive timetable for the latter.

How did the State get into this unique position? The Corps of Engineers and the State shared in the cost of developing the lake with the Corps retaining ownership of abutting lands. For the most part, this ownership corresponds to a specified lineal height above the flood pool elevation. In some cases this lake buffer strip is rather narrow. In other cases, additional lands were purchased to protect and control waterside views, etc. While many argue that the buffer is too narrow and possibly not totally enforced, in fact, there are no properties abutting the lake that have direct access to the lake because of this buffer, except those leased by the State.

The State leases its recreational areas, boat ramps and campgrounds from the Corps of Engineers on a long term basis. In turn, the State subleases this prime waterfront property to private developers. A good example at Lake Monroe is the Four Winds Marina initially built by Ramada Inns and recently sold to Aircoa. The Four Winds Marina is a resort hotel with recreational facilities and water facilities including direct lake access. At present, there are only two ways of enjoying the lake, either going to a public access point or to the Four Winds.

If there are no major restrictions on subleasing of leased recreation areas, the major portion of which consists of open land, then it would be inconceivable for another commercial-resort type of development locating at the lake and competing with Four Winds without similar lakeside access unless the development were non-water oriented. If the lake access is taken away, there should be little, if any, incentive to locate a resort near Lake Monroe.

The State was asked if it had a master plan for development of its property around the lake. The reply indicated that the Department of Natural Resources felt the Lake Monroe Regional Waste District 201 Plan was the Lake Master Plan.[1]

The State's influence in a real estate sense is not just confined to its properties, but has application and impact upon seasonal and second home development expectations around the lake. An example in this regard is The Pointe. The Pointe is a planned condominium development being constructed along the northwestern shoreline of Lake Monroe. The shoreline is fairly wooded and The Pointe does not have lake access. In fact, the tree line along the shore all but hides the view of the lake from intermediate and lower slope positions below the tree line. The developers of The Pointe have spent considerable monies and taken great pains to develop key front end recreational draws such as a tournament golf course, club house and pro-shop. Each phase or village within the development will have tennis courts and swimming pools as the major attractions. Even with these attractions, the developers made arrangements with the Four Winds Marina (which sits on land subleased from the State) for access to the lake for boating and swimming.

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[1] Telecon, with Carl North, Department of Natural Resources, State of Indiana.

Assuming there will be a limit to the number of private agreements that the Four Winds Marina can make, the combined draw of The Pointe recreation and water access will make it extremely difficult for other developers to compete with it, since later developments will probably not be able to emulate The Pointe's fortuitous position, i.e., not able to overcome this competitive advantage, unless the State subleases additional lands.

If there are to be no more subleases and arrangements for private lake access, then all subsequent developers will have to appeal to a market of persons prepared to drive a considerable distance to a lake that they cannot see or directly use, except at public facilities, the use of which will probably be self-governing due to congestion that will discourage use somewhat.

10.3 SEWER SYSTEM DEVELOPMENT

Basic to the question of servicing Lake Monroe is the question of how such a system might develop. Sewer systems are not developed in a vacuum years in advance of actual need. Nor are systems conceived, designed, funded and constructed overnight. The regional system proposed around Lake Monroe in the 201 Plan consists of a force main with each individual proposed development served by a lift station, lifting the sewage up the hill. A force main is pressurized, and access is limited to points where sewage may be injected into the system. This would tend to effectively limit the size of developments around the lake to large ones. It is not likely that small developments would be able to pass through pump station and other associated costs onto the cost of housing as effectively as large scale developers.

Except for public recreation areas and facilities and The Pointe seasonal development, there is no current or near term demand for a regional collection system around the entire lake. Of the developments proposed around the Lake, few if any are located near enough to one another to easily support a regional collection system. The collection system would have to pass through large sections of open land with little prospect of picking up additional flows along the way. Few, if any of these seasonal projects, can at this time produce even a tentative time table or development schedule. In fact, no one can say with certainty, if or even when, these projects will ever be constructed, although it seems safe to conclude that The Pointe will be completed.

This means that the lakewide system as proposed in the LMRWD 201 Plan would have to develop internally with each development culminating in either a package treatment plant or connection to the regional collection system, if accessible at that time in that area. This will increase the total economic cost of the system since the temporary sewage treatment costs will have to be quickly written off. The financing of such a system has to be tenuous when one considers that potential customers along the way may not be ready to participate at the time the collector system is being financed, or that if one or two developments along the system have financial difficulties or fold, the costs would then be picked up by few users.

The U.S. Forest Service is in a position to influence the routing and timing of interceptor development, and it has gone on record as intending to withhold permission for sewer line easements across its property. In some cases, this will merely mean rerouting, in others it might mean that no service can be provided.

The west side of the lake has been shown to be more suitable for development because it is more accessible; the general terrain is more amenable for development; and temporary sewerage service is now available there. Three of the five seasonal developments proposed on the south side of the lake could pump their sewage up and discharge effluent out of the lake basin without having to construct an expensive collection system. Such an opportunity is not possible on the north and west side of the lake. The proposed development around the causeway near Paynetown recreation area is physically located closer to the existing Winston Thomas treatment plant than to the proposed Salt Creek site, but drains toward the lake.

Even if the sewers were to be constructed, there is no guarantee that every seasonal development proposed for the lake will in fact be constructed. Rather, this will depend more upon the market demand and the money market for seasonal housing.

10.4 PROJECTED LAND USE PATTERNS/ZONING

No real pattern has developed to date around Lake Monroe. The lack of an overall coordinated land use plan for Lake Monroe is detrimental to orderly development in light of the intricate web of governmental, quasi-governmental, and private interests in and around the lake. There is not a single level of government that is not intricately involved in Lake Monroe's development; and yet there is not one single agency or mechanism that can guarantee or ensure such coordination at this time.

The actual responsibility for land use planning and the legislative controls rests with the Monroe County Planning Commission. The Lake Monroe Regional Waste District, a single purpose agency responsible for utility planning and development, has taken the role of the lead agency in fostering coordinative land use planning. This agency contracted with the Indiana University of Public Affairs to prepare an environmentally oriented land capability plan for eventual use by local officials. This plan reportedly will show how to best plan for the long term use and enjoyment of the land compatible with continued beneficial use of the lake. Unfortunately, this material is only approaching the stage where it can be utilized in land policy planning efforts; and this report must precede those efforts.

The Monroe County Zoning Ordinance is the land use control document in effect around the lake. This document was prepared after the Lake Monroe 201 plan, but the zoning pattern does not particularly correspond to or reflect the sewer plan, except in some isolated spots.

The land surrounding Lake Monroe is zoned for a wide variety of activity patterns. Most of Salt Creek and Polk Townships are located within a Forest Reserve Zone.[2] The intent of this zone is to include rough terrain and also publicly owned forest land. While these townships are almost exclusively zoned for reserve usage, which is quite restrictive in its standards, huge tracts of land within this reserve are set aside for business, presumably to allow for planned developments and commercial recreational activities within these two townships. The largest business districts correspond roughly with the Graves-Monroe-Inland Steel tracts near the north end of the causeway, and Tan-Tara on the south side of the causeway. Neither of these projects now have a definitive time schedule. It would appear that the force main needed to serve these units will require an easement across Federal Forest Land, unless the Moore Creek inlet on Lake Monroe is to be crossed nearer the Paynetown recreation area. The county zoning plan requires a minimum lot size of 4.5 acres in this forest reserve, and the county health department requires a permit for lots under ten acres in size. Within the business district, residences may be built at a density of 6 units per acre with public sewers.

Most of the remainder of the lakefront within Clear Creek and Perry Townships is zoned for residential usage with .4 acre lots allowed with community water systems and on-lot sewerage; and .8 acre lots with on-lot water and sewer systems. The only substantial sized business district here adjoins the Fairfax recreation area and Harrodsburg. What fostered this delineation of these two districts in this location is not known. The Consultant has no knowledge of specific developments proposed here. It is interesting that the only planned unit development under construction in the county was not zoned similar to the many other potential seasonal developments located around the lake which were zoned for business.

Another curious zoning district configuration is the noticeable lack of an agricultural district within the Lake Monroe area except for the property immediately surrounding The Pointe. Considering the potential for sewering this area, it would appear that this would be a prime area for additional development. The intent of the agricultural district is, according to the County Zoning Ordinance, to provide areas in which little or no urbanization has occurred or is likely to occur in the near future. Lots used for residences in the agricultural district would have to be the same size as in the Forest Reserve District, 4.5 acres.

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[2] Monroe County Zoning Ordinance

The remainder of the land is residentially zoned. The intent of the residential zoning is either to include areas that can be served by water and sewage utility systems, principally near state highways and present urban centers, or to include areas that have been subject to urbanization on a scattered pattern, principally along county highways.

Under the terms of the county zoning ordinance, approximately 16.5 square miles of land around the lake is zoned for residential use; 3.5 for agricultural; 25 square miles for forest reserve; and about 3 square miles for business. Under the present zoning umbrella, some 13,200 lots could be spread out on these 16.5 square miles supporting some 32,000 to 40,000 people, with on-lot sewers and septic tanks flowing into rather unsuitable receiving soils.

1Q5 PHYSICAL CONSTRAINTS

The lake is assumed to have an absolute limit in terms of recreation carrying capacity although this limit has not yet been ascertained. Some sources have indicated that based upon certain standards of boats per acre of water, the lake is now overutilized. The Department of Health has evidently held off issuing permits to discharge effluent into the lake. Statements have been made that the lake is environmentally phosphate sensitive. Land activities such as clear cutting for development and exposing unstable and easily erodable steep soils, if uncontrolled, will only increase the potential for soil erosion and sedimentation. Once areas are developed, additional nutrients will be derived from fertilizer runoffs, etc., even if the sewage problem is solved. Development not sewer connected will only increase the potential for groundwater seepage and lake pollution. As more development occurs, it is probable the usage of the lake will increase. With increased boating, the chance for wave and bank erosion and oil spill finding its way into the reservoir becomes more likely.

With few exceptions, the general landform, geology, topography soils and rather poor road structures would not be considered conducive to normal construction and development. The road pattern is almost exclusively restricted to the ridges, since the impoundment covers the former valley floor.

Lake Monroe's soils are severely restricted in terms of development of new highways, basements, and on-lot septic systems. The major limiting factor is the steep slope, and the next is shallow bedrock conditions. The Lake Monroe terrain is quite rough and steep, and highly erodible. The area's present land use is predominantly woodland. Any changes in land use are bound to have more of a physical impact here than elsewhere on less sloping lands.

It is anticipated that ongoing land capability studies and future models will better pinpoint the specific limiting parameters of the environment at Lake Monroe. The environmental capability plan is a forerunner in this regard, and is expected to culminate in the adoption of additional environmental constraints and controls on development designed to protect the quality of the lake and its environs.

10.6 DISCUSSION OF SECONDARY IMPACTS

The secondary impacts from the proposal generally fall into one of two categories, physical or fiscal impact. The physical impacts relate to changes as they result from cutting of vegetation, clearing and improvement of land, paving over of pervious soils, reworking the landscape, changes in density of population and their effects on traffic, sewage flow, water usage, increased demands upon lake usage, fertilizer runoffs, etc. The fiscal impacts include all the increased demands upon municipal services and facilities resulting from the development.

Fiscal impacts are normally evaluated in a cost-benefit analysis wherein the incremental changes in revenue of a development are evaluated against the incremental increases in the cost of government. Normally, in a community development cost-benefit analysis, the number and type of housing units planned are of paramount importance, since this has a direct bearing upon the family size, the number of children and their impact upon the school system. The latter usually comprises the major share of total municipal expenditure, sometimes reaching 75% of the total expenditure. Data shows that, for example, apartments will generate less school children for each similar size unit than a single family house. In addition, the larger the housing unit the greater the expectation for more school age children.[3] The remaining municipal costs often are considered on a per capita basis.

But second and seasonal home developments do not fit well into a normative cost-benefit analysis. Each such analysis must be tailored to each specific plan, and a picture of local services and financial structure. In seasonal developments, school age children become less of an issue since so few of these units will become occupied year round by families with small children that will enter the local school system. Without entering into a detailed set of calculations, resort and seasonal developments accrue taxes to the school system without the concomitant influx of students, and therefore usually overshadow other municipal cost considerations, such as road and bridge maintenance, other public works, hospitals, fire protection, police protection.

The shortcoming of most cost-benefit analyses is their preoccupation with the operational stage of development while often ignoring the initial capital expenditures that such developments may foster, such as new road, storm sewers where not previously present, etc.

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[3] Cost Revenue Impact Analysis, Urban Land Institute, June 1975.

Without a fairly definite plan to peruse, it is difficult to forecast the magnitude of demand for services and facilities that might be generated by these proposed lakeside developments. In fact these developments could be augmented or diminished overnight to change the picture rapidly. With seasonal housing, the length of occupancy and type of covenants and restrictions on subleasing are also critical in determining equivalent demands upon municipal services. The Lake Monroe area does not appear as an area having much in the way of a four season attraction, having little to offer in the winter. Therefore, less than full year-round occupancy probably could be anticipated.

10.7 IMPACT OF NOT SEWERING LAKE MONROE

The impact of not developing the force main interceptor and providing regional sewer service will fall mainly upon the expectations of the larger developments proposed around the lake. It is the large scale developers who stand to benefit by such a system, and conversely, get hurt if it is not built.

The physical nature of this regional system encircling the lake would essentially limit individual lot by lot hook-up, since a pump station would be needed. This means that certain population levels would need to be reached before pumping can become economical to the lot owner or small developer. The lack of service would probably be no more limiting than a regional force main.

The Pointe development did not wait for the regional system and therefore gained permission to build package treatment plant and discharge into Clear Creek. Design plans are now underway to add the Fairfax Recreation Area to the Caslon package plant, thereby eliminating the most significant sewage discharge to Lake Monroe. This plant might relieve the development pressure from other lake locations for the interim period, since it could serve this area that has the more amenable landform and better potential for development.

TASK 11

MITIGATIVE MEASURES FOR MINIMIZED PHYSICAL EFFECTS

11.1 CONSTRUCTION ACTIVITIES

11.1.1 Revegetation

For right-of-ways, it is desirable to maintain low growing vegetation that will allow for easy access to the area and at the same time prevent undesirable native vegetation from overgrowing the area. Dr. Marion T. Jackson, Professor of Life Sciences at Indiana State University, offered the following information on plant species which could be used to revegetate the area.

"1. If it would survive that far south, Sweetfern, *Myrica asplenifolia*, would be a strong choice. It is characteristic of the Indiana Dunes area where it covers extensive areas, particularly in combination with bracken fern, *Pteridium aquilinum*. *Myrica* is presumed to be a nitrogen fixer, which would enhance its value as a site-recovery shrub species.

"2. *Corylus americana* (American hazelnut) and *Ribes cynosbati* (pasture gooseberry) are shrubs with wildlife value, and possible cover species. Both occur in extensive stands when well established. *Corylus* grows quite tall on better sites, but usually reaches less than a meter on poor soils. Both species are found throughout Indiana.

"3. *Ceonothus americanus* (Jersey tea) does well on dry sites where it grows less than a meter tall. It has possibilities as a cover species, but I doubt that it would exclude tree seedlings or other later successional species.

"4. Two species of shrubby dogwoods offer promise. Roughleafed (*Cornus asperifolia*) is a wet site species for the most part where it grows quite tall. Gray dogwood (*C. racemosa*) is found in both wet and dry sites, but is more common in N. Indiana than in the south. It is generally of a shorter stature (1-2 m) than roughleaf dogwood. Either would be an interesting species for trial plantings.

"5. Coralberry (*Symphoricarpos orbiculatus*) occurs in extensive stands in both full sun and under thin forest canopies. The limber shrub is usually less than a meter tall. This species seems to be one of the strongest candidates for utility corridor plantings.

"Other possibilities include Lonicera japonica (Japanese honeysuckle) although I personally prefer native to exotic species. Also, the honeysuckle often gets out of hand and spreads flagrantly. Some of the greenbriers (Smilax) could be used, but they often grow in nearly impenetrable tangles. Perhaps such species could be used to impede the corridor construction crews!" Reference: Jackson, M., 1975, personal communication.

Before the construction begins, the Consultant recommends that an Indiana botanist such as Dr. Jackson be consulted.

In the case of revegetation to prevent erosion of areas disturbed by major excavation and grading activities, the objective is to select a grass or group of grasses which germinate quickly. Pasture grasses which are known to grow well in the area include alfalfa, red clover, broome grass, tall fescue and orchard grass.

11.1.2 Pipe Crossings in Stream Beds

Type of Site:

1. Rock strata, gradually sloping banks, rocky stream bed. Generally found in upper drainage area.

2. Alluvial stream, high banks, significant depth to rock strata under stream bed. Generally found in lower drainage area.

Comments:

Type 1 is a young stream, with high velocities during floods, steep slopes. Large rocks are transported by flow, and bars may form at various locations and move along the stream.

Type 2, in alluvial material, is probably meandering. Difficult to predict future stream channel alignment. Bed is made of fine material. Significant scour during runoff events.

Suggestions for Minimizing Environmental Impact

1. Conduct construction operations during dry weather when stream flows are low, on the average.

2. Store excavated material on stream banks, outside of stream bed and above anticipated flood level for mean annual flood.

3. If stream is flowing, consider a downstream rock dam, possibly with a filter layer on the upstream face, to prevent downstream movement of material.

4. In Type 1 stream, excavate pipe into rock strata, blasting if necessary. Use selected fill, topped with native stream bed stone. Keep top of pipe 1 ft. below normal stream bed, as a minimum.

5. For Type 2 stream, especially if banks are high, consider the use of a pipe bridge, rather than burying pipe. These streams are generally unstable and scour or meandering may expose buried pipe. Keep pipe bridge foundations away from stream bank as far as possible.

6. If pipe is buried in a Type 2 stream, bury deep enough that general scour during floods will not disrupt pipe.

7. During trenching, consider dikes to divert one-half of the stream around construction, fill, and perform construction on other side. A better method would be to divert entire stream around construction area until backfill is completed. If dikes are used, hydrology of area should be re-evaluated to determine optimum duration of construction. Stability of materials should be evaluated with respect to erosion and slippages.

8. Replace stream bed in as near its original condition as possible.

9. Protect disrupted banks with mulch or temporary lining (jute mesh, etc.). Seed with native vegetation. Re-establish vegetation as soon as possible.

10. In severely disrupted areas of the stream bank, consider the use of rock riprap to prevent erosion.

11.1.3 Pipes Laid Parallel to Stream Banks

In general, follow good construction erosion control practices.

1. Keep excavation as far from stream bank as possible.

2. Use ditch checks in sloping areas to prevent erosion along pipe trench. Checks may be of any less erodible materials such as clay.

3. Seed, mulch, and re-establish native vegetation as soon as possible.

4. Use temporary linings such as jute mesh in steep areas.

5. Use temporary sediment basins to collect sediment in areas where runoff is concentrated. Hay bales could be used in some instances to form temporary dikes.

6. Avoid disrupting or intercepting natural drainage areas. Bury pipe deep enough to return bed to original elevations.

7. Keep excavated material away from stream channel, and revegetate disrupted areas.

8. Leave existing vegetation on all areas where possible until necessary to remove to grade for construction.

9. Stockpile topsoil to be spread on surface when preparing final grade.

10. Use temporary seeding on areas that must be scalped but will not be finished for a period of time.

11.1.4 Channel Relocations

This is a difficult problem, because when a stream channel in alluvial material is disrupted, it will usually cause a reaction at some other location, such as headcutting, general channel erosion, deposition, or new meandering. There is no particular problem in nonerodable stream channels except for the disruption of the aquatic habitat and sediment production.

In an alluvial channel, the relocated channel should have the same characteristics, as far as possible, as the channel which has been replaced. For example, if the new channel is shorter than the old channel, the friction slope will increase and erosion will occur. Thus, a solution would be to add riprap to increase friction losses in the new channel and protect the bottom. Generally, riprap channels are quickly rehabitated by aquatic organisms and have a somewhat natural appearance. The use of smooth concrete channel linings for relocated channels should be avoided. Ideally, the relocated channel should have as near as possible the same length, bank width, and bed features as the old channel. Since this is not possible, one should isolate the main considerations and study each separately and as a combination. The principal considerations for diversion locations are:

1. Outlet conditions
2. Topography
3. Land use
4. Agricultural operations
5. Soil type
6. Length of slope

The design of a diversion involves:

1. The above generalities
2. Velocities as high as possible but not eroding
3. Grades dependent on site
4. Peak runoff capacity dependent on site
5. Appropriate friction coefficients
6. Available construction equipment

Finally, they should be inspected annually and after heavy floods.

Suggestions for Minimizing Environmental Impact

1. Conduct operations during dry period when stream flows are low.
2. Replace old channel in kind, and design based on river mechanics to transport same sediment load.
3. Store excavated materials outside flood levels (mean annual flood).
4. Consider use of open graded rock dam with filter material on upstream face to prevent downstream movement of sediment.
5. After construction, seed, mulch, and revegetate disrupted areas. Use temporary linings or riprap as necessary to prevent erosion in channel.
6. Use standard erosion control measures as necessary:

   Ref: "Guidelines for Erosion and Sediment Control Planning and Implementation" EPA-R2-72-015, U.S. Environmental Protection Agency, Washington, D.C. August 1972.

   "Erosion Control on Highway Construction Projects" Project 20-5, Topic 4-01, Natural Cooperative Highway Research Program, Highway Research Board, Washington, D.C., Draft January 1973.

11.1.5 Tunneling Operations

Environmental impact should not be serious.

Generally:

1. Dispose of excess material in an acceptable manner to prevent erosion and downstream sediment problems. Example, outside stream flood plains, revegetate, no steep slopes.

2. Revegetate disrupted areas, or protect with artificial materials to prevent erosion.

11.2 PLANT OPERATION ACTIVITIES

11.2.1 Sludge Disposal by Land Application

Minimizing the adverse environmental impact which could result if excessive amounts of sludge were applied on land is contingent on proper application rates. It is recommended that a research project be conducted to determine the best application rates for sludge produced at the plant when it is constructed for the different soil types on which it will be applied.

11.2.2 Odor Control

Control of odors at wastewater treatment plants is of utmost importance particularly when communities are located near the treatment plant. This has been an occasional objection to the Winston Thomas treatment plant. Sources of odors include the following:

1. Grip and grit chambers both in and out of service.
2. Septic wastewater screenings and grease at wetwells.
3. Pre-aeration tanks in which odorous gases are stripped from wastewater.
4. Primary settling tanks where gasification of sludge may be caused by infrequent sludge withdrawal and floating solids.
5. Biological facilities in which aerobic conditions may not always be maintained. Causes such as clogged diffusers in aerators or surcharged air-intake channels should be identified.
6. Tank walls, open channels, boxes and pits which are cleaned infrequently.
7. Secondary settling tanks with accumulations of floating solids.
8. Over chlorination.
9. Oxidation ponds with odorous sludge accumulations.
10. Digesters of the anaerobic or aerobic type in which optimum conditions have not been maintained.
11. Sludge holding and thickening facilities in which the contents are not aerobic.

12. Sludge dewatering facilities processing odorous sludges.

13. Incinerators that have exit gas temperatures below 1400°F.

The existing plant is overloaded. The new plant will not be overloaded; and, furthermore, it will use the activated sludge process with denitrification which will lend itself to better controls and efficiency of operation. If odors should develop at the new plant, the following mitigative measures will be used:

1. The first control strategy will evaluate physical and chemical control measures that are permanent and effective in reducing odors below the detectable level at the plant property line. These may consist of:

    a. Oxidation by chlorine, ozone, or hydrogen peroxide.

    b. Chemical precipitation of sulfides.

    c. Treatment of liquors such as supernant, centrate, filtrate, and thickener overflow with lime powdered carbon, or chemical oxidants.

    d. Adjustment of loadings upon all biological facilities to a level not in excess of design capacity. This may include requiring pre-treatment of strong industrial wastes to an acceptable strength.

    e. Maintaining optimum operating conditions in all treatment facilities.

    f. Installation of environmental enclosures as required. Filter and scrub air prior to discharge to atmosphere.

2. The second control strategy will evaluate corrective measures to be implemented should an odor episode occur such as killing of biological processes by toxic substances. These corrective measures may include:

    a. Staffing and equipment to identify sources and causes of odors either at the plant or at the discharge source responsible for the odor

    b. Masking of odors

    c. Emergency chemical treatment

    d. Interim modification of plant operation

11.2.3 Disinfection of Treated Sewage Effluent

Because of the possibility that chlorinated effluent could contain toxic compounds which would reach the water supply of Bedford, 13 miles south of the Lake Monroe dam, it may be desirable to choose an alternative disinfection system. It is recommended that chlorinated sewage from the Winston Thomas plant be analyzed by gas chromatographic mass spectropholometric (GC-MS) techniques to determine if potentially toxic compounds are present. The results should be compared to unchlorinated sewage at Winston Thomas to determine which compounds result from the addition of chlorine. The Environmental Protection Agency's laboratory in Athens, Georgia may be commissioned to do the GC-MS work. If toxic compounds are detected alternative disinfection agents which should be considered include:

1. Ozone

2. Bromine chloride

3. Chlorine - sulfur dioxide (i.e., chlorination - dechlorination)

4. No disinfection

11.2.4 Visual Impact

The visual impact of the plant sites can be mitigated by redesigning the landscape features, creating berms from site excavated materials and by strategically locating these berms where they will minimize the more unsightly visual elements of the plant site. Much of this can be done in conjunction with rechanneling, floodproofing and soil erosion and sedimentation control activities. In addition, trees and natural vegetations make ideal foils to hide unsightly views. The added benefit resulting from carefully designed mitigative efforts will be better noise control, since noise travels on a line-of-sight.

11.2.5 Clear Creek Recreation

Reference has been made to the fact that Clear Creek is sometimes used for non-white water leisure type canoeing, and as such, is one of the few creeks in the area with enough flow for canoeing. While the Consultant was unable to substantiate this claim, it is quite certain that with the Salt Creek site configuration in low flow periods such as the summer, there will not be enough water in Clear Creek to support canoeing since most of the flow now in the summer consists of effluent. The only way to remedy this would be to augment Clear Creek flow upstream with dams, etc., which is not likely to happen.

11.2.6 Zoning

The non-structural mitigative measure with the greatest potential for easing land use frictions which are more apparent during the operational stage is the standard zoning ordinance and the floodplain ordinance. Most sewage treatment plants are located in or near the flood plains, since a low-lying location is necessary to facilitate gravity flow and to provide for ready discharge to a waterway. This location is less than ideal for residential locations since they normally can less afford expensive flood protection devices. A floodplain ordinance can restrict and control floodway and floodway fringe development. Such a provision is incorporated into the City of Bloomington's zoning ordinance which would affect the Winston and South Rogers sites. The county zoning ordinance, applicable to all other sites, does not have a similar provision.

Rarely is a sewage treatment plant located in the middle of an existing residential development. Usually the plant is located prior to residential development. One aspect of zoning that can be used to ensure that this situation is controlled to require that sewage treatment plants, because of their unique operating conditions, come in for a special exception or a conditional use permit. Usually this requires that special preconditions be met in the course of plant location such as extra wide setbacks and yards, and the special exceptions procedure usually requires a public hearing and public notification of adjoining property owners as a prerequisite to any hearing. The Bloomington Zoning Ordinance is silent with respect to sewage treatment plant locations and does not precondition or make special exception to plant location, while the county zoning considers the sewage treatment plant as a special exception and requires open and unutilized yards having 300 feet depth as its sole condition.

Probably the most pertinent aspect of zoning in relation to mitigating the effects of sewage treatment plants would be to zone the site and immediate area for other than residential uses to ensure that people do not build at the edge of sewage treatment plants. This would protect people from making poor locational decisions that they may later regret, and then use pressure to work for the removal of sewage treatment plants, pump stations, or other utility facilities.

The Dillman and Ketcham Road sites are protected from residential encroachment. Both are located within a rather large industrial district that does not allow location of residences therein. At Salt Creek, the land is zoned for residential usage, which under the provisions of the Monroe County Zoning Ordinance allows for a variety of residential housing types ranging from single family to apartment units depending upon the availability of public sewerage. While it seems unlikely that residences would be constructed in this poorly drained bottom land, the current zoning ordinance would, on the face, allow such a condition to develop.

The Rogers Site is apparently not zoned. The County Zoning Map shows it within the city's jurisdiction, and the City Zoning District boundaries terminate at Gordon Road. This should be rectified.

The development pattern around the Winston Thomas site is fairly well established and would probably not be affected by any change in zoning designations, although redesignation of the low density residential strip bordering the northern boundary of the site might better be classified as light manufacturing, the present site designation.

12.1 Irreversible and irretrievable commitments of resources to the proposed action should it be implemented.

Two classes of irreversibility and irretrievability need to be identified in evaluating the commitment of resources. Class I is the irreversible and irretrievable decisions that cannot be reversed such as the expenditure of energy. And Class II commitments are the decisions to commit resources which are not likely to be retrieved or reversed during the useful life of the project.

Class I commitments resulting from the construction of the proposed sewage treatment plant include the capital costs, energy, and labor necessary to construct and make operational the proposed facility.

Class II commitments for the proposed STP include: the operational requirements of chemicals, energy, mechanical equipment, labor, the use of 60 acres of land zoned as industrial and the tax loss associated with alternate uses of the site. Clear Creek will be relocated and channelized to provide maximum utilization of the Dillman Road site. The habitat for typical wildlife such as birds, rabbits, field mice, etc. will be diminished.

13.1 The relationship between local short term uses of man's environment and the maintenance and enhancement of long term productivity.

The construction and operation of the proposed South Bloomington Sewage Treatment Plant will result in efficient treatment of sewage generated in the South Bloomington Service Area and a general improvement in the water quality of Celar Creek and Salt Creek. To accomplish this improvement in surface water quality a commitment of energy and resources necessary to operate the proposed facility (flow through the STP is projected to be 15 MGD by the year 2000) and the removal from the tax roles of approximately 60 acres of land zoned industrial will be required.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

1. A 15 MGD two-stage activated sludge sewage treatment plant with rapid sand filters and sludge treatment via aerobic digestion and centrifugation should be constructed at the Dillman Road site to serve the South Bloomington Service Area.

2. The present 1.9 MGD diversion from the south service area via a force main to the Blucher Poole STP should continue.

3. The processed sludge from the proposed STP should not be applied to farmland until: 1) the extent of the PCB problem in Bloomington has been determined 2) corrective actions are taken that reduces the PCB levels to those determined to be safe for agricultural application. When the PCB problem is resolved, land spreading of the sludge on farmland at agronomic rates consistent with Federal and State of Indiana regulations for land application is one recommended alternative. The composting operation that presently utilizes some of the Winston Thomas (W.T.) sludge should be sampled to determine if heavy metals or PCB's due to the W.T. sludge are at concentrations such that application of the composted material should be restricted to certain uses until the heavy metal and/or PCB problem is resolved. If PCB's or heavy metals are present at an unacceptable level in both processed sludge and the compost product, then landfilling of the south service area sludge should be practiced until the nature of the sludge changes (due to pretreatment requirements or changes occur in the composition of the sludge) so that the alternatives of composting and land spreading can meet the standards promulgated by Federal and State agencies.

4. Regionalization of the South Bloomington Service Area and the Lake Monroe Regional Waste District as proposed in the Bloomington 201 plan is not cost-effective. The Dillman Road STP could provide service to the communities of Smithville and Sanders via an 80,000 GPD interceptor if it is determined that this is the most cost-effective alternative. (An approval facilities plan would have to be completed for the LMRWD prior to any grant award for design and construction of these facilities. Furthermore, it must be demonstrated that properly operated and maintained septic systems cannot function as designed due to existing soil and bedrock conditions.)

5. Other areas in the Lake Monroe District can be adequately served with existing and proposed facilities, e.g. Paynetown, served by an existing package plant and the Caslon plant serving the Pointe and Fairfax. The Caslon plant could also be expanded (if cost-effective) to handle a flow from Harrodsburg and from development along Old State Route 37. Another possibility, if Harrodsburg would be served by the plant, would be to move the Caslon package plant to an alternate location at the confluence of Clear Creek and Little Clear Creek.

CHAPTER 6

FEDERAL/STATE/LOCAL AGENCY COMMENTS AND PUBLIC PARTICIPATION

The written comments in this chapter were received or transmitted during the preparation of the draft EIS. The order of the comments is as follows:

A) Federal, B) State, C) Local Agencies and Interest Groups, and D) letters from individuals.

United States Senate

MEMORANDUM

Please note the attached letter from a constituent which I am forwarding for your consideration. It would be greatly appreciated if you would check into this matter. Upon completion of your investigation, please advise me of the status of this case in duplicate and return the original letter in an envelope addressed to the attention of Darry Sragow.

Thank you for your assistance.

Sincerely,

Birch Bayh

Birch Bayh
United States Senator

INDIANA UNIVERSITY
Department of Physics
SWAIN HALL—WEST 117
BLOOMINGTON, INDIANA 4740

TEL. NO. 812— 337-26

November 13, 1975

Senator Birch Bayh
363 Old Senate Office Bldg.
Washington, D.C. 20510

Dear Senator Bayh:

We have enclosed a copy of a letter sent to Mr. Hirt of the EPA, Region V, in Chicago. It is important that the full interests of the community be considered in this matter.

As mentioned in the letter to Mr. Hirt, some members of the Bloomington Utilities Service Board have placed a high priority upon the economic consequences of the delays in initiating our wastewater treatment project. The delays reflect a long public discussion and a broad concern with the ecological impact of the location of the treatment plant. A priority that is governed solely by economic concerns and not responsive to the environmental considerations is, in our opinion, misplaced.

It is important that you understand that the costs for this project have not increased solely because of inflation. More detailed engineering studies and changes in the treatment ~~cost~~ process have also affected the cost estimates.

The Environmental Impact Statement being prepared by EPA will resolve our particular problem and bring the public debate to a conclusion. The citizens of the United States must have an agency that works in a responsibl manner to preserve the best interests of our land. The economic and ecological factors must be viewed together and properly balanced. The Congress has given this responsibility to the EPA and defined the Environmental Impac Statement as one of the instruments to be used to meet this obligation. The EIS must be prepared carefully and completely if it is to serve its purpose.

Sincerely yours,

David Dilcher
David L. Dilcher
Member, Utilities Service Board
Dept. of Plant Sciences
Indiana University
Bloomington, IN 47401

Hugh J. Martin
Hugh J. Martin
Member, Utilities Service Board
Dept. of Physics
Indiana University
Bloomington, IN 47401

DLD/HJM:mlc
enclosure

ENVIRONMENTAL PROTECTION AGENCY

DEC 10 1975

Honorable Birch Bayh
United States Senate
Washington, D.C. 20510

Dear Senator Bayh:

The Environmental Protection Agency is fully aware of the need to address all pertinent issues in the siting of new sewage treatment facilities for the South Bloomington Sewage Service Area as indicated in the Nov. 13, 1975 letter from David L. Dilcher and Hugh J. Martin. To aid us in our environmental evaluation the consulting firm, Gilbert Associates of Reading Pennsylvania, was hired and is completing an analytical report on key issues related to the proposed projects. When the draft environmental impact statement is issued, the final report of Gilbert Associates will also be available, and a public hearing will be held to consider all comments on these documents.

I am also enclosing a copy of the Nov. 3, 1975 letter from other members of the Utilities Service Board and our response of Nov. 20, 1975. Based on the concerns of the citizens of Bloomington, it is clear to us that the EIS process provides a viable mechanism for resolution of these important concerns.

Your interest in this matter is appreciated and copies of the draft and final EIS will be mailed to you when they are available.

Sincerely yours,

/S/

Valdas V. Adamkus
Acting Regional Administrator

cc: Office of Legislation
Planning & Standards Branch
OCIR

10,139

United States Senate

Respectfully referred to:

E.P.A.
Waterside Mall
401 M. Street, S.W.
Washington, D.C. 20460

Because of the desire of this office to be responsive to all inquiries and communications, your consideration of the attached is requested. Your findings and views, in duplicate form, along with return of the enclosure, will be appreciated by

✓

Senator Vance Hartke
U.S.S.
Attn: Janis McClintock
447 Federal Building
Indianapolis, Indiana
46204

RECEIVED
11/20/75
AX

COOK INCORPORATED

November 3, 1975

The Honorable Vance Hartke
313 Old Senate Office Building
Washington, DC 20510

Dear Senator Hartke:

The Utilities Service Board of the City of Bloomington recently requested the Environmental Protection Agency to provide information concerning the direct and indirect costs of the Environmental Impact Statement that EPA is currently preparing on Bloomington's proposed wastewater treatment facility. (See the attached letter of August 21, 1975, from Utilities Project Coordinator Richard S. Peoples.) As you can see from Mr. Harlan Hirt's response of September 19, 19 which is also attached, EPA does not seem disposed to divulge this information, which we feel should be a matter of public record.

As citizens of Bloomington who are very interested in this project and as federa taxpayers who are concerned with the total environmental and economic costs of the new wastewater treatment facility, we sincerely believe we have the right to know what the direct and indirect costs of the Environmental Impact Statement will be. As one of our elected federal representatives, we would appreciate it if you would look into this matter to help us secure this information.

Sincerely,

Eileen L. Schaller, President
Utilities Service Board, City of Bloomington
William A. Cook, Member USB
David Ryan Board Atty.
Robert P. Schmidt, Vice-President, USB
William B [illegible]

mjh

Enclosures

cc: Mr. Harlan Hirt

ENVIRONMENTAL PROTECTION AGENCY

DEC 11 1975

Honorable Vance Hartke
447 Federal Building
Indianapolis, Indiana 46204

Dear Senator Hartke:

This is in response to your request for information concerning a letter you received from several members of the Utilities Service Board (USB) of the City of Bloomington, Indiana. The Environmental Protection Agency has responded to the Cook Incorporated letter of Nov. 3, 1975 signed by several members of the USB. Our response is detailed in the attached Nov. 20, 1975 EPA letter.

During November a second letter from two other members of the USB was received by EPA. I am attaching this letter and the local newspaper article which accompanied it. These letters illustrate the differing viewpoints which exist on the USB regarding the preparation time for the draft EIS. EPA is concerned about project delays but also recognizes the need to fully evaluate all alternatives in the proposed project and the associated environmental impacts.

When the draft EIS is issued, the final report of Gilbert Associates will also be available, and a public hearing will be held to consider all comments on these documents. Based on the concerns of the community it is clear to us that the EIS process provides a viable mechanism for resolution of these important concerns.

Your interest in this matter is appreciated and copies of the draft and final EIS will be mailed to you when they are available.

Sincerely yours,

/S/

R. J. Schneider
Acting Regional Administrator

SIMILAR LETTERS WERE SENT TO REPRESENTATIVES LEE HAMILTON AND JOHN MYERS IN RESPONSE TO THEIR REQUESTS FOR INFORMATION ON THE SAME LETTERS.

ENVIRONMENTAL PROTECTION AGENCY

DEC 4 1975

Mr. Gary R. Kent
Director of Utilities
City of Bloomington Utilities
P.O. Box 1216
Bloomington, Indiana 47401

Dear Mr. Kent:

This letter is a response to your November 20, 1975 letter concerning preliminary findings with respect to the Environmental Impact Statement for the South Bloomington-Lake Monroe Service Area. As you know EPA has received a draft report from the consulting firm of Gilbert Associates on the proposed wastewater treatment facilities. While some revision of this report is necessary and ongoing, a clear position with respect to comparing the Salt Creek Site and the Clear Creek Sites can be stated.

We will not support construction of the new sewage plant for the South Bloomington Service Area at the Salt Creek Site in the Draft EIS. We have determined that three Clear Creek Sites (Winston Thomas, Dillman Road and Ketchum Road) are preferable to the Salt Creek Site on an environmental, economic and geographic basis. Preliminary present worth analyses indicate that the Salt Creek Site is more costly than the three Clear Creek Sites by several million dollars.

Furthermore, selection of the Salt Creek Site would result in less centralization of sewer interceptor facilities, extensive disruption of the Clear Creek stream banks, a poorer quality effluent, a less reliable sewage treatment facility, and might cause an acceleration of the development of the Lake Monroe Area prior to a full opportunity by the local planning commission, with appropriate citizen input, to discuss and evaluate land use options for the Lake Monroe Area.

I wish to point out that the above position is not a final determination by EPA which can only be taken in the Final EIS after reviewing and responding to agency and public comment. Our present analyses indicates that the Salt Creek Site is not cost-effective and is not the optimum environmental alternative. We cannot advise you on the manner in which to respond to your purchase option on the Salt Greek Site. This letter can only identify the position that will be presented in the Draft EIS.

Mr. Gary R. Kent
Page Two

DEC 4 1975

When the Draft EIS is issued, the final report of Gilbert Associates will also be available and a public hearing will be held to consider all comments on these documents.

Sincerely yours,

/s/

Valdas V. Adamkus
Acting Regional Administrator

November 20, 1975

Cook Incorporated
925 South Curry Pike
P. O. Box 489
Bloomington, Indiana 47401

Gentlemen:

We have received your letter of November 3, 1975 regarding costs of preparing the EIS for the Bloomington project and are responding within the procedures of the Freedom of Information Act.

My staff advises that the Utilities Service Board and others involved in the Bloomington EIS have provided excellent cooperation. We definitely want to continue in that spirit of cooperation. Unfortunately, most of the information you are requesting is not available without consuming a great deal of effort in additional study and would require a number of subjective assumptions which would leave a good bit of doubt as to the result. We simply do not have the manpower to conduct such a study.

The only readily available fact in response to your request is that our contract on the EIS is for $32,690. We estimate we may devote approximately one man-year of in-house effort at an estimated cost of about $16,000.

Although we recognize that compliance with the National Environmental Policy Act does involve delays when Impact Statement preparation is initiated late in the planning process, it was our judgment that the Bloomington proposal required an EIS to satisfy the statute. We also feel that the potential savings in environmental impact and dollar costs outweigh the potential costs of lost time.

I trust that through continuing cooperation we can bring the process to a rapid conclusion and move forward to design and construction at an early date.

Sincerely yours,

/S/

Henry L. Longest II
Director, Water Division

HDHirt:pm 11/20/75

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

September 19, 1975

Mr. Richard S. Peoples, Project Coordinator
City of Bloomington Utilities
P. O. Box 1216
Bloomington, Indiana 47401

Dear Mr. Peoples:

In your letter of August 21, 1975, you requested direct and indirect cost data to all parties related to the preparation of the Bloomington-Lake Monroe Indiana Draft and Final EIS. First, let me identify that the decision to do an EIS on a proposed project is not based on direct or indirect costs, but on whether or not the proposed Federal action (in this case a grant award for construction of wastewater treatment facilities) is a major Federal action significantly affecting the quality of the human environment (NEPA Section 102(2)(c)). Furthermore, the final regulations for Preparation of Environmental Impact Statements of EPA, 40 CFR Part 6, April 14, 1975, Sections 6.200 and 6.510, identify criteria for determining when to prepare an environmental impact statement.

With respect to the Bloomington-Lake Monroe, Indiana project, it was apparent to EPA, based on the NEPA Act and our regulations, that unresolved environmental concerns, such as the optimum location for a new wastewater treatment facility existed and could most efficiently be resolved through the environmental impact statement process. As you know, both the Bloomington Utilities Board on April 4, 1975 and the Mayor of Bloomington on April 10, 1975 officially requested an EIS for the proposed project, being aware that the EIS process generally takes 8-12 months until a grant award can be made.

Once a Federal agency or a Federal court has declared that an EIS is required, the time period necessary to complete the EIS process is considered an essential step for the project to proceed. (The courts have, in fact, stopped construction of nuclear power plants, etc., until satisfactory EIS was prepared.)

The EIS process also provides the public a greater opportunity to identify their concerns and have their concerns addressed in a written document subject to review by the public, local, state and Federal agencies.

In the environmental impact statement EPA will address costs through the cost effective analysis required under P.L. 92-500. The cost effectiveness analysis with proper concern for environmental impacts will be the basis upon which a specific recommendation for wastewater treatment facilities will be made. Direct and indirect costs associated with the project will not be identified unless they relate specifically to the cost effective analysis required under P.L. 92-500.

Sincerely yours,

Harlan D Hirt

Harlan D. Hirt
Chief, Planning Branch

B) STATE COMMENTS

STATE of INDIANA

INDIANAPOLIS, 46204

1816

DEPARTMENT OF NATURAL RESOURCES
JOSEPH D. CLOUD
DIRECTOR

September 12, 1975

Mr. Dale Luecht
Project Officer
Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Luecht:

We have reviewed the proposed wastewater treatment facilities to serve the South Bloomington-Lake Monroe area and find that no known historic sites will be effected.

This area has not been surveyed and if you find that your project has a direct effect or is in close proximity to any older structures, please contact us at the earliest possible time.

I understand that you have already been in contact with the Glenn A. Black Archaeology Laboratory about archaeological sites in the area. Any recommendations they forward should be included in your assessment.

Very truly yours,

Joseph D. Cloud

Joseph D. Cloud,
Director
Department of Natural Resources

JDC:EG:jm

RECEIVED

PLANNING BRANCH - Region

C) LOCAL AGENCIES' AND INTEREST GROUPS' COMMENTS

CITY OF BLOOMINGTON UTILITIES
P. O. BOX 1216
BLOOMINGTON, INDIANA 47401
TELEPHONE AC 812 339-2261

November 20, 1975

Dale Luecht
Planning
U.S. E.P.A. Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Mr. Luecht:

During the past few months, we have stressed the importance of the completion of the draft EIS prior to December 12, 1975 as the City has invested and stands to lose some $20,000 on land options at the proposed Salt Creek site. I realize that it is impossible for you to issue the draft EIS by December 12th.

It is imperative that we receive as much advise and assistance as possible from your agency prior to the expiration of these options. Therefore, we are hereby requesting that you consider our situation and its urgency. We do need guidance from E.P.A. so that the City can decide whether it should exercise, renew, or drop the options on the Salt Creek site.

Any assistance you can give will be most appreciated

Sincerely,

Gary R. Kent

Gary R. Kent
Director of Utilities

GRK/sew

cc: Utilities Service Board
    Richard Peoples, Project Coordinator

CITY OF BLOOMINGTON UTILITIES
P. O. BOX 1216
BLOOMINGTON, INDIANA 47401
TELEPHONE AC 812 339-2261

August 21, 1975

Dale Luecht
Planning
U.S. E.P.A. Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Mr. Luecht:

It would seem appropriate that the citizens have an opportunity to know the cost for an Environmental Impact Statement. There appears to be three vital areas which need to be explored in a study of this type:

1. Cost to the Federal government for the study. This should include employee time for an Environmental Impact Statement and cost of any outside consultants.

2. Cost to the state and local bodies who have instigated the project. This section should include items such as principle and interest on funds expended on the project. Parts of prior engineering or design, which may have been discarded by the Environmental Impact Statement, should be included.

3. Increased cost of construction resulting from inflation during the period required for preparation of the Environmental Impact Statement.

For the sake of good order, we, the Utilities Service Board of Bloomington, Indiana respectfully request that the Environmental Protection Agency include a section in its Environmental Impact Statement entitled Summary of Direct and Indirect Costs for the Environmental Impact Statement.

Sincerely,

Richard S Peoples

Richard S. Peoples
Project Coordinator

RSP/ses

cc: Utilities Service Board
Environmental Impact Statement (file)

INDIANA UNIVERSITY
Department of Physics
SWAIN HALL—WEST 117
BLOOMINGTON, INDIANA 47401

TEL. NO. 812— 337-2650

November 13, 1975

Mr. Harlan Hirt
Chief, Planning Branch
EPA Region V
230 South Dearborn
Chicago, IL 60604

Dear Mr. Hirt:

You recently received a letter from several members of the Bloomington, Indiana, Utilities Service Board expressing their concern with the delays and costs associated with the preparation of the Environmental Impact Statement for our wastewater treatment plant. We want to make it clear that this position is not supported by all members of the board. The initial request for an EIS was made by the Utilities Service Board knowing full well that costs and delays would be incurred. To now make an issue of the dollar costs can only serve to thwart the reasons for the initial request.

The location of the wastewater treatment plant has been a controversial issue in our community for several years and has remained so despite extended public discussions. Both economic and ecological concerns were expressed. In our nation's past, decisions of major importance were often based on economic considerations alone. The Environmental Impact Statement insures that both economic and ecological factors are considered in decisions involving public funds. A proper balance between these factors is necessary if, in the future, we are to sustain the quality of life we enjoy and preserve the land we occupy.

We appreciate the work that EPA is doing on this project and the responsibility that is assumed when preparing an EIS. A hastily-prepared statement would not be adequate. To dismiss the concerns of any segment of the community would not be proper. The time required for careful preparation of the EIS will be only a small fraction of the time that we must live with the actions that are to be taken.

Sincerely yours,

David Dilcher

David L. Dilcher
Member, Utilities Service Board
Dept. of Plant Sciences
Indiana University
Bloomington, IN 47401

Hugh J. Martin

Hugh J. Martin
Member, Utilities Service Board
Department of Physics
Indiana University
Bloomington, Indiana
47401

DLD/HJM:mlc
Copies to: Senators Bayh, Hartke; Representatives Meyer, Hamilton

Total environment 'real' economics

Bloomington, Indiana
Herald-Telephone
10/26/75

By DON JORDAN
H-T Outdoor Editor

Environmental protection is coming under fire from all quarters of business and industry these days with critics beating the same drum with the same tune that protecting the environment costs too much.

Part of the difficulty environmentalists have in countering these charges is that the large majority of business-oriented individuals put price tags on everything. But how do you put a price tag on the environment?

Many enviornmental thinkers point to the what they call "externalities" of continued growth without environmental concerns figured.

LYNTON K. CALDWELL, IU's environmental and political science leader, is fond of pointing out these externalities of expansion when the total environment is not considered.

When William Cook of the Bloomington Utilities Service Board recently blasted an environmental impact statement being prepared by the U.S. Environmental Protection Agency, he insisted that economics is part of the the environment.

Environmentalists accept that argument, but Cook went one step farther, claiming that economic considerations must always come first, then environmental protection is fine.

But what about those externalities?

Dollar figures can be placed on providing schools, streets, sewers, water lines, sidewalks, transportation. These factors must also be considered as part of the environment, and all have large price tags afixed. And, when all of these environmental factors are included, costs incurred by government in drawing up impact statements fade in comparison.

COOK CLAIMED THE IMPACT statement for the new south sewage plant will end up costing millions. But what will be the ultimate cost to the citizens of Bloomington and Monroe County if an environmental mistake is made in selecting the site for the plant?

Utilities Director Gary Kent has pointed out that when new service areas are picked up by the city, funds used to purchase the utility lines from developers come from utility revenues.

In other words, all customers served by the utility end up paying for new service. Such practices result in millions of dollars over long periods of time.

Likewise, when new utility services like the new sewage plant are built, it is the customers who always end up paying the bills. Utility rate increases result and tax increases are eventually needed to provide those myriad other services demanded by new residents. Tax base increases seldom provide increased income over the long run when new services must be maintained into infinity.

BY NARROWLY DEFINING the environment, business and industry leaders detail economic considerations and seldom talk about the environment as a whole.

Who asks about the environment of Bloomington and Monroe County as a whole — not just that narrow economic spectrum?

Unfortunately, the asking of that question is in this area left in the hands of private citizens or environmental groups like Sassafras Audubon Society, Sierra Club, Izaak Walton League and others. This is unfortunate, but necessary, since government officials are many times not sensitive to preserving the environment that makes this area attractive.

Claude Ferguson recently pointed out that he likes this area and wouldn't move to a metropolitan area like New York or Washington for double his salary. Likewise, said Ferguson, his wife wouldn't leave her favorite turkey wood for any salary.

PEOPLE HAVE MOVED to the Bloomington area because they like the total environment of the area. The sprawling forests and ridgelines provide a relief from the tensions of modern society.

When considering economics as a part of the environment of this area, it would be good to wonder how far we can go in changing it before people in other areas say: "I wouldn't take double my salary to move from here to someplace like southern Indiana."

When those words are uttered is when the real economic crisis will hit southern Indiana.

COOK

November 3, 1975

Mr. Harlan D. Hirt
Chief, Planning Branch
U.S. E.P.A. Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

At the direction of the Utilities Service Board of the City of Bloomington, Mr. Richard S. Peoples, Utilities Project Coordinator, in a letter of August 21, 1975, requested a summary of direct and indirect costs for the Environmental Impact Statement that the Environmental Protection Agency is currently preparing on our proposed wastewater treatment facility. In your response to Mr. Peoples of September 19, 1975, you state: "Direct and indirect costs associated with the project will not be identified unless they relate specifically to the cost effective analysis required under P.L. 92-500."

As you are well aware, the Environmental Protection Agency has requested a great quantity of information from the Bloomington Utilities Department, the consulting engineers Black & Veatch, and other interested parties. To our knowledge all of this information has been provided with willingness; nothing has been withheld or refused. Since the direct and indirect costs of the Environmental Impact Statement are a genuine concern of local residents, we feel that the Utilities Service Board's request for this information from the Environmental Protection Agency is both legitimate and reasonable. Your response to Mr. Peoples' letter, however, seems to indicate that the Environmental Protection Agency does not believe that the people of Bloomington have the right to know this information. As citizens of Bloomington who are very interested in this project and as federal taxpayers who are concerned with the total environment and economic costs of the new wastewater treatment facility, we respectfully disagree.

When a study such as an Environmental Impact Statement is undertaken, the cost of the study is just as important as the other data that is collected. We feel that the value and merits of an Environmental Impact Statement should be measured--at least in part--by the cost of collecting the information. An Environmental Impact Statement takes time; in this day, time, unfortunately, can be measured by the rate of inflation. Without knowing the cost due to lost time, might not the economic environment of an entire community be jeopardized? Here in Bloomington, for example, the possibility of a moratorium on growth in the southern drainage area exists because the present wastewater treatment plant is overloaded and antiquated. Inflation since 1972 has increased the cost of Bloomington's proposed wastewater facility from $27 million to $40 million. This inflationary cost increase suggests that each month used to study the environment costs $360,000. We realize that it is impossible to place a price tag on the environment; however, we believe that it would be in the best interests of all people if the Environmental Protection Agency would thoroughly review its Environmental Impact Statement process, keeping in mind the economic ramifications of such studies.

In our particular case here in Bloomington, we sincerely feel that withholding this information about the direct and indirect costs of the Environmental Impact Statement seriously hampers the spirit of cooperation that the people of this community have attempted to foster between themselves and the Environmental Protection Agency. With this in mind, we once again request that the Environmental Protection Agency provide us with a statement that details the costs related to the Environmental Impact Statement currently being conducted on Bloomington's proposed wastewater treatment facility.

Sincerely,

mjh

cc: Senator Birch Bayh
Senator Vance Hartke
Congressman John Myers
Congressman Lee Hamilton

COOK INCORPORATED

NOV 13 1975

November 3, 1975

The Honorable John Myers
103 Cannon House Office Building
Washington, DC 20510

Dear Mr. Myers:

The Utilities Service Board of the City of Bloomington recently requested the Environmental Protection Agency to provide information concerning the direct and indirect costs of the Environmental Impact Statement that EPA is currently preparing on Bloomington's proposed wastewater treatment facility. (See the attached letter of August 21, 1975, from Utilities Project Coordinator Richard S. Peoples.) As you can see from Mr. Harlan Hirt's response of September 19, 1975, which is also attached, EPA does not seem disposed to divulge this information, which we feel should be a matter of public record.

As citizens of Bloomington who are very interested in this project and as federal taxpayers who are concerned with the total environmental and economic costs of the new wastewater treatment facility, we sincerely believe we have the right to know what the direct and indirect costs of the Environmental Impact Statement will be. As one of our elected federal representatives, we would appreciate it if you would look into this matter to help us secure this information.

Sincerely,

Allen L. Schaller, President
Utilities Service Board, City of Bloomington

Dick Fee

William R. [illegible] USB

Neil Ryan Board Atty.

mjh Robert P. Schmuckl, Vice President, USB

Enclosures W Milne

cc: Mr. Harlan Hirt

CITY OF BLOOMINGTON UTILITIES
P. O. BOX 1216
BLOOMINGTON, INDIANA 47401
TELEPHONE AC 812 339-2261

August 12, 1975

Dale Luecht
Planning
U.S. E.P.A. Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Mr. Luecht:

Attached are the position papers for the individual Utilities Service Board members concerning the improvement program as outlined in the Bloomington South Facilities Program.

I must apologize for the delay in getting this document to you as the positions were presented by the Board at the June 3, 1975 Utilities Service Board meeting.

If you have further questions for the Board or need clarification, please direct your questions to me and I will see that they are transmitted to the Board.

Sincerely,

Gary R. Kent

Gary R. Kent
Director of Utilities

GRK/ses

cc: James R. Quin, Gilbert Associates, Inc.
Utilities Service Board members

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
AUG 15 1975
PLANNING BRANCH - Region V
FILE NO.

UTILITIES SERVICE BOARD

JUNE 3, 1975

The Utilities Service Board members gave the following recommendations as to site alternatives for the proposed treatment plant site:

DAVID DILCHER: Dilcher affirmed his belief that Dillman Road is the best site for the location of the proposed sewage treatment plant. He stated that this site best satisfies the needs of the City and the Region for the following reasons:

1. It accomodates a gravity flow for the main lines and interceptors adaptable for picking up both City and Regional waste.
2. It is removed from residential areas and can be properly screened. With proper county zoning, residential development can be restricted.
3. It would provide a higher level of treatment for the effluent.
4. It would provide a more constant and easily controlled treatment because the two-stage plant planned for this site is less susceptible to upsets.
5. It would be less distruptive to the Clear Creek Valley.
6. The Lake Monroe Region could tie in,in total or in part.
7. The cost would be equivalent to or less than the Salt Creek site in the long run considering the lower operations and maintenance expense.
8. It would not encourage stringer type development along a long outfall sewer and will allow the development of city-centered facilities.
9. Space would be provided for expansion to 40 MGD.
10. It would best serve the Region by providing easy pick-up from the Smithville and Paynetown areas and it would not require such long interceptor sewers as the Salt Creek site.
11. There is the distinct possibility of a force main from the southwest section of the Lake being extended up Clear Creek Valley to Dillman Road.

UTILITIES SERVICE BOARD

JUNE 3, 1975

WILLIAM COOK: Cook indicated that he accepts the Black & Veatch summary that the Salt Creek site is the most desirable. The selected plan includes a gravity sewer from the existing South Plant along Clear Creek to a 20 MGD plant at the Salt Creek site.

The selected proposal is as described under Section Ten of the Facilities Plan except that the initial design flow is 20 MGD. This site is the most desirable based on environmental concerns and cost effectiveness. In addition, the plan is well adapted to providing service to the Lake Monroe Region. If service were to be extended to the Lake Monroe Region the selected plan would be modified by the construction of a 5 MGD plant addition approximately fifteen years after the initial start-up.

Availability of land is a great difference between the Salt Creek and Dillman Road sites. Unlimited land is available at the Salt Creek site for disposal of wastes, composting, and future plant expansion.

The Salt Creek site could service Lake Monroe and also the southern Monroe County area. Since we supply their water Cook feels we should consider providing sewage treatment. He feels that we must provide for the future so that growth will take place in southern Monroe County. Cook mentioned that in the Land Suitability Study the southwest section is the greatest portion of land available for any kind of development at Lake Monroe. Cook indicates disagreement with Dilcher as far as cost of operation is concerned. He stated there would be a $200,000 operations savings on a year-to-year basis of operation at the Salt Creek site which would result in lower sewer bills for residents.

JACK MARTIN: Martin listed his reasons in support of the Dillman Road site. He feels that a higher degree of sewage treatment is offered by the two-stage plant proposed for the location. Because the effluent discharged from Dillman Road eventually passes Salt Creek a higher degree of treatment is indicated and with less impact for Salt Creek.

The main difference Martin sees between the Dillman Road and Salt Creek sites is that the Dillman Road site is the most cost effective for the near future. The arguments for Salt Creek are based upon predictions for the distant future and projections about what will happen in different areas of the City and the Lake Region. Because construction costs for Salt Creek are three million dollars more than for Dillman Road, Martin feels it would take a great number of years for Salt Creek to become more cost effective than Dillman Road. The areas of clear cost differential according to Martin are: (1) the difference between the one-stage Salt Creek plant and the two-stage Dillman Road plant, and (2) the difference between the outfall sewer required by Salt Creek and a shorter sewer required by Dillman Road. If drying beds were constructed at Dillman Road the sludge disposal costs would be about the same. The degree of treatment offered at Dillman Road would result in 97.5% removal of BOD and suspended solids as opposed to 95.7% removal offered at Salt Creek. The two-stage plant would employ additional people in the daily plant operation. Martin stated that the costs are based on a 20 MGD plant flow which is a higher flow than has been projected for the first twenty years.

Martin went on to state that he finds the question of a Regional plant a rather difficult concept. In looking at the argument that a central plant is the most effective way to treat sewage, it seems unrealistic that sewage must be moved so far to implement that concept. In applying this to our present situation, Martin stated that with the exception of the southwest part of the Lake the Salt Creek site is relatively inaccessible to the rest of the Region and Bloomington. Martin indicated that his belief was that perhaps a separate plant should be considered for the southwest part of the Region.

Martin then outlined his uncertainties concerning the projections for the Region. He feels that looking at a 40 MGD plant to service a Bloomington population of 200,000 is looking too far into the future. He finds the Region predictions troublesome for the fact that if the plant is built at Salt Creek to service the Region and the projected growth fails to occur then the plant will be serving a very small base of people. Martin stated that Region growth predictions are based on: (1) growth in a basically rural area projected to increase by 1007, (2) growth in the Lake Monroe recreational areas is predicted to double, and (3) large growth of those building developments around the Lake. Martin disagrees with the rural area growth stating that it would be difficult to determine the high density areas. He concluded his remarks by restating his feelings that the arguments for the Salt Creek site seem to be much more uncertain and difficult to assess than arguments for Dillman Road.

RICHARD FEE: Fee stated that as a result of ten years experience he feels that the most suitable site is the one located as far downstream as possible the Salt Creek site. He indicated that the former sewage treatment plant was located just two miles north of the present Winston Thomas site so if we are not to make the same mistake again we should move as far downstream as possible. Fee feels that the Salt Creek site would be better suited to meeting changing dilution requirements, sludge disposal requirements, and degree of treatment in future years.

In response to the argument that string-type development will be encouraged, Fee gave two reasons stating why he feels this will not occur:

1. The pipe is neither in the flood plain nor inaccessible to normal development.
2. The land around it is not suitable for development. There are too many quarries on the west and it is economically not feasible to build there.

ROBERT SCHMUHL: Schmuhl stated that he favors the Salt Creek site. According to Schmuhl initial costs would be higher at Salt Creek but long term operating and maintenance costs and the cost for equipment replacement would be lower.

Schmuhl feels that there would be a greater expanse of available and suitable land at Salt Creek. This would be beneficial because more efficient sludge disposal and sufficient space for additional facilities would be provided. At Dillman Road there would be no room for construction of additional facilities if further advanced treatment processes were mandated in the future.

AILEEN SCHALLER: Schaller stated that because the total costs between the Salt Creek and Dillman Road sites are not much different that cost cannot be a basis for decision.

Although no permanent environmental damage will result from either site, Schaller feels there are two areas of possible concern: (1) the outfall sewer, and (2) the Lake Monroe Region. With careful attention to revegetation, long range damage will be prevented in the area of the outfall sewer. As for damage to the Lake Monroe Region, the plant will not be crucial to development but will instead be of use to the Region.

Regarding other environmental concerns, Schaller stated we must not overlook the aesthetic and odoriferous considerations. She stated that the plant should only be located along a major entry corridor to the City as a last resort. The Dillman Road site would be on constant display, while the Salt Creek site will use less of our dwindling energy year in and year out.

Physical characteristics should also be considered in choosing a plant site. The plant should be located on level ground relatively free of rock. There should be adequate room for expansion and on-site sludge disposal. Undeveloped land should be available for a buffer zone. There should be natural screening of the plant.

In closing Schaller stated that the Salt Creek site meets all of the preceding criteria while the Dillman Road site meets none.

Further discussion of the plant sites followed the Board members presentations. Fee recognized additional pluses for the Salt Creek site as being the lessened effects of an accident due to greater dilution possible. He also mentioned that the plant would probably be resized down to 15 MGD by the Environmental Protection Agency.

Utilities personnel were then asked to give their opinions as to the plant site choice. Director of Utilities Gary Kent stated that major considerations should be the cost of operation as far as local dollars are concerned the balance of commodities in operation, the ability to serve the potential growth and the plant layout. He indicated that some costs are questionable for both sites but he favors the Salt Creek site. Utilities Treatment Engineer Mike Phillips added that he felt the Salt Creek site was best from the operating standpoint and Project Coordinator Rick Peoples concurred.

Fee moved, Schmuhl seconded a motion that the Salt Creek site be recommended to the Environmental Protection Agency as the site chosen by members of the Utilities Service Board and by Black & Veatch engineers to be the most suitable for the proposed treatment plant. The vote was four to two in favor of the Salt Creek site.

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PLANNING BRANCH - Region V
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EVALUATION OF GILBERT REPORT

A direct comparison between the Gilbert Report and the Facilities Plan prepared by Black & Veatch is extremely difficult. However, our preliminary review reveals a number of areas where serious questions exist. Among these are:

1. On page 5-1, a misunderstanding of the nitrogen discharge requirements of the State of Indiana is apparent. On Clear Creek the winter requirement should be 3.0 and not 6.5. On Salt Creek the summer discharge should be 7.9 rather than 3.0.

2. The additional cost of facilities to provide second stage nitrification at Clear Creek sites is estimated on page 6-14 of the report at $1,722,000. It would seem that this second set of aeration, sedimentation and sludge handling facilities should cost about 20% of the liquid treatment cost (page 6-14) or about $3,400,000.

3. The cost of operating and maintaining a two stage nitrification plant on Clear Creek is estimated at only 8% more than operating a single stage nitrification plant at Salt Creek, despite the fact that the Salt Creek plant must nitrify only during the summer months while a Clear Creek plant must nitrify twelve months a year.

4. Either no rock excavation is included or the quantity of rock is seriously underestimated for the necessary channel relocations for Clear Creek sites.

EVALUATION OF GILBERT REPORT
PAGE TWO

5. The cost of the gravity sewer to the Salt Creek site shown on page 36-A is over-estimated. The price for all sewers larger than 42" in diameter is based on an over-sized pipe that is not needed to carry the anticipated flow. Current quotations on sewer pipe are from 20 to 35% less than those used for each pipe size.

6. In our experience, we have never found it necessary to construct and maintain a permanent road for vehicles along an outfall sewer. (page 8-6)

7. On page 10-1, the report states that the Salt Creek site is not adequate to sustain land application of sludge produced there. A call to Joseph B. Farrell, Chief of the Ultimate Disposal Section, of the Municipal Environmental Research Laboratory, of the U.S. EPA in Cincinnati, revealed that the formula used in the Gilbert Report was not current. Using the correct figures would allow about 2 1/2 times the sludge loading proposed in the report.

8. The report states on page 10-20 that the costs for the recommended haul and application of sludge from Dillman Road and Salt Creek sites are within 8% of each other, even though the sludge application site is immediately across the creek from the Salt Creek site, according to Plate 3. In addition, the report assumes that the owners of this property will accept the sludge.

9. It is extremely doubtful that a new 15 mgd two stage nitrification treatment plant can be built on the Winston Thomas site west of the existing facilities as stated on page 3-1. In addition, the report reveals a lack of understanding of the existing Winston Thomas facility when it refers to the obsolete, fixed-nozzle, sprinkling filters as "Bio-filters."

10. The assumption that pumping 1.9 mgd north to the Blucher Poole plant will provide a less costly treatment scheme than handling it in its natural watershed. (page 1-4) It does not consider the fact that the Blucher Poole plant will have to be upgraded to meet substantially the same standards as discharges to Clear Creek.

11. Page 31-A of the report discusses the need for one pump station to serve Smithville while Plate 3, illustrating this facility, shows two.

12. The statements in Section 5 to the effect that two stage nitrification by a plant on Clear Creek is, per se, superior to single stage nitrification on Salt Creek, suggests that it is considered that the State of Indiana has not properly allocated waste loading to the streams of the State.

If a detailed comparison between this Report and the Facilities Plan would be of value, we at Black & Veatch respectfully request that this Report be presented on a basis comparable to the Facilities Plan.

Bloomington, Indiana
May 3, 1975

Steve Riggins, President
Monroe County Plan Commission
County Courthouse Annex
Bloomington, Indiana

Dear Mr. Riggins:

A number of organizations concerned with implementation of the Land Suitability Study of the Lake Monroe area, in process of completion by the Indiana University School for Public and Environmental Affairs, would like a place on the agenda of the May 20th meeting of the Monroe County Plan Commission in order to present two requests:

1) for formulation and adoption of a policy and plan for the use of the Lake Monroe Land Suitability Study, and

2) for consideration of applying for a Planning Grant for a similar study for the remainder of the County.

Enclosed is a statement which we are sending to the members of the Monroe County Plan Commission, the Monroe County Council, and the Monroe County Commissioners.

Yours sincerely,

Anne Rippy

Anne Rippy
809 S. Stull, representing the
organizations

cc: Bob Snoddy

TO: THE MONROE COUNTY PLAN COMMISSION

FROM: CONTACT, BLOOMINGTON LEAGUE OF WOMEN VOTERS, BLOOMINGTON ENVIRONMENTAL QUALITY AND CONSERVATION COMMISSION, SASSAFRAS AUDUBON SOCIETY

The Land Suitability Study being conducted by the Indiana University School of Public and Environmental Affairs covers approximately a 100 square mile area around Lake Monroe and will provide a valuable data base and Land Capability Model for use in planning for that area. It is an important first step in terms of the study and planning needed for the entire Lake Monroe Watershed.

The value of such a study, however, will not be realized until the results of the study are incorporated into planning and decision-making for that region. We ask that the Monroe County Plan Commission formulate and adopt a policy and plan for the implementation of the study. Those involved in making the study will demonstrate how to retrieve and interpret the data, but we need a firm committment to its use to gain the benefits inherent in the study.

We believe that the time is appropriate, also, for undertaking a comprehensive land use study for the remainder of Monroe County with the goal of incorporating the two studies with the zoning ordinance recently adopted into a Comprehensive Master Plan for the County.

The need for such a study is apparent. For example, the Indiana University School of Business recently predicted a 25,000 population increase in the south drainage basin of the County within the next two decades. We need to identify critical areas such as fragile lands, renewable resource lands, natural hazard lands, mineral resources, etc and protect them through planning---as well as seek an over-view of our land-use problems and potential.

Funding for such a study is available through a Federal 701 Planning Grant which would pay 2/3 of the cost with the local governing body providing 1/3. 701 Planning Grant funds are allocated by the Indiana State Planning Services Agency which could conceivably give high priority to a project which would include land-use planning for Lake Monroe as one of its components.

Many kinds of data are available which would minimize the cost of the study. The Soil Survey of Monroe County is well advanced and expected to be completed within two years. The Indiana Geological Survey will provide geological and hydrological data and both the Soil Conservation Service and the Geological Survey will provide expert services in interpretation of this data. A recently completed study of the karst region of the west side of the County should prove valuable. The services of the Region 10 planner and cooperation with the planning services of the City of Bloomington could also expedite planning and minimize costs.

We would appreciate early consideration by the Monroe County Plan Commission of an application for a Planning Grant.

RECOMMENDATIONS OF THE
ENVIRONMENTAL QUALITY AND CONSERVATION COMMISSION
ON THE SITING OF THE PROPOSED
BLOOMINGTON SEWAGE TREATMENT FACILITIES

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RECOMMENDATIONS OF THE ENVIRONMENTAL QUALITY AND CONSERVATION COMMISSION ON THE SITING OF THE PROPOSED BLOOMINGTON SEWAGE TREATMENT FACILITIES

1. General Background

Almost since its inception during the spring of 1972 the Environmental Quality and Conservation Commission (EQCC) has been studying the environmental aspects of the placement of a new waste-water treatment facility in southern Bloomington. This is demonstrated by the record of the EQCC meetings, whichis summarized in the Appendix. The EQCC has discussed the siting of the facilities during many civic meetings, has supported several pertinent studies, and has participated in studies carried out by others. We have presented recommendations and relevant information to the citizens of Bloomington, to the Common Council, to various members of the City Administration, and to State and Federal officials. Relying on these experiences and the understanding we have gained from them, we present this report as our analysis of the environmental factors associated with the siting of the proposed facilities.

From an environmental perspective, there are two major siting options: the proposed Salt Creek site and the alternative sites on upper Clear Creek. Possible alternative sites mentioned to date include the present Winston Thomas site and sites on South Rogers Street, on Dillman Road, and on Ketcham Road.

II. Recommendations

Based on their community involvement referred to above and on their professional expertise in such areas as physics, chemistry, ecology, and soil science, the members of the EQCC have unanimously concluded that all of the Clear Creek sites are environmentally preferable to the Salt Creek site. Of the Clear Creek sites, the EQCC believes that the total environmental impact of construction and operation at the Dillman Road site will be the least. Therefore, the EQCC recommends that the treatment facility be placed at the Dillman Road site. This report will present our reasons for this recommendation; first, the environmental issues differentiating all of the Clear Creek sites from Salt Creek; second, the environmental and social issues which differentiate Dillman Road from Winston-Thomas and South Rogers St. There are four main reasons for selection of a Clear Creek Site:

a. The terrestrial and aquatic destruction involved in running the outfall sewer to Salt Creek will be avoided.

b. The level of effluent quality from the Clear Creek sites will be greater.

c. The Salt Creek site is within the floodplain of Salt Creek, directly below the spillway at the reservoir and located on a soil type known to be subject to waterlogging. (See Soil Survey)

d. The possibility of adverse secondary effects of facilitated development at Lake Monroe because of placement at Salt Creek will be less severe.

The primary considerations differentiating Dillman Road from Winston Thomas/St. Rogers St. are the adverse aesthetic impact of a wastewater treatment facility placed in the more densely populated areas and the social impact of relocation of several families living in a trailer park on the proposed site.

III. Comparison of the Environmental Effects of Clear Creek and Salt Creek Siting

A. Outfall Sewer Effects

Locating the waste-water treatment plant at the distant Salt Creek site requires a long outfall sewer. There are five alternative sewer routes from Bloomington to that site:

(1) under Clear Creek;

(2) along Clear Creek, but higher upon the banks and slicing across the creek's bends;

(3) as in (2), but using a force main to cut across the broad westerly bend of the creek;

(4) along Clear Creek to the Ketcham Road area, then across the hills via a force main to lower Little Clear Creek, then south along Little Clear Creek and Clear Creek;

(5) as in (4), but to upper Little Clear Creek.

The proposed outfall sewers to the Ketcham Road and Dillman Road sites follow route (2) above, but for much shorter distances. Both the South Rogers Street and Winston Thomas sites would require 9000 ft. force mains running up the Clear Creek bed from the proposed southeast interceptor sewer. It should also be noted that, should the Lake Monroe Regional Waste District decide to have its wastewater treated at a Bloomington Clear Creek facility, a force main running overland from

from Smithville to the Clear Creek bed will have to be built.

Outfall sewer construction and maintenance will have detrimental environmental effects; the longer the sewer is, the worse these effects will be. These effects can result from earth-moving during construction and may also include permanent environmental damage caused by right-of-way clearance and maintenance. All of these effects are magnified by the proximity of a natural area, Cedar Bluffs. Following is a more detailed consideration of these factors.

The right-of-way for construction of sewer alternative (2), which is the one recommended by Black & Veatch, is 100 feet wide and about 60,000 feet long. An area of six million square feet will thus be subjected to physical abuse. A trench averaging twelve feet deep will be dug down the length of this right-of-way. Much of the 4.3 million cubic feet of earth that will have to be removed is limestone, which will have to be blasted out. Some of this spoil will be bulldozed and graded to level the right-of-way for maintenance access. It is rather difficult to believe that bulldozing and blasting on this scale could be done with an eye to "limiting environmental disruption" (Black & Veatch, p. X-16). It is more reasonable to believe that construction activity will result in the destruction of much terrestrial and aquatic wildlife habitat, in addition to impairing the stream's aesthetic value.

Despite the promise to grade and reseed "as soon as practicable," it may work out that, considering the frequency of rain and flash-flooding in the area, erosion may set in before vegetative cover does. In the case of alternative (3), erosion may also result from unrevegetated sewer line easements in the hills above the creek. In any case, the resultant siltation of the stream could have an effect on the aquatic biota more permanent that that caused by sewer construction itself.

The EQCC also has reservations about the effects of the twenty-odd creek crossings proposed under alternatives (1) and (2). The provisions for keeping the line from being dug up by the action of the stream are not described in the Black & Veatch report. This makes it impossible to comment on them specifically except to hypothesize that there may be permanent changes in the substrate of the creek which could affect stream biota, flow characteristics, and aesthetics adversely.

Though specific techniques for right-of-way maintenance have not been described by Black & Veatch, usual procedures involve defoliation with herbicides. This would constitute a chronic perturbation to the immediate and neighboring wildlife habitat as well as a possible source of pollution from runoff.

Another problem is the proximity of the Cedar Bluffs area to the Clear Creek sewer route. Sewer construction and maintenance could affect the integrity of this area through the resultant noise, dust, and impairment. While the sewer does not pass through the area, alternatives place the line just across the creek from it. On the basis of the above considerations, the EQCC recommends that the important potential negative environmental effects of the outfall sewer be minimized by minimizing the length of the sewer, subject to constraints described below.

B. Effluent Quality Effects

The Salt Creek facility is to be a one-stage plant, while current state water quality standards require that a Clear Creek plant, because of the low dilution capacity of the receiving stream, be a two-stage plant. A one-stage plant is somewhat more susceptible to rapid changes in plant variables such as water volume than a two-stage plant. Rapid changes in water volume do occur in the Bloomington area during the summer. It is conceivable that at that time a one-stage plant could discharge improperly treated effluent.

More importantly, however, a one-stage plant will be unable to discharge effluent of a quality high enough to meet the standards currently required for 1983 by Public Law 92-500. Yet the Black & Veatch study which judges the cost effectiveness of the Salt Creek and Dillman Road sites to be similar assumes a one-stage plant at the Salt Creek site. The EQCC questions the rationale behind a twenty-year cost effectiveness study predicated on water quality standards that will be superseded by more stringent ones after only five years. Clearly, with respect to present water quality standards, a Dillman Road plant would be more cost effective than a Salt Creek plant, because the former would discharge a higher quality effluent for the same cost; with respect to future standards, a cost effectiveness study would have to consider fines the City might have to pay due to the emission of an illegal effluent by a Salt Creek plant. The EQCC concludes that, environmentally, and legally, a two-stage plant is better than a one-stage plant and that, economically, a two-stage plant at Dillman Road is better than a two-stage plant at Salt Creek.

An added benefit of a Clear Creek site with the relatively clean effluent it is required to discharge is the potential recreational use of Clear Creek as a canoe stream. Such areas are not abundant around Bloomington. If the Salt Creek site is chosen, the flow in Clear Creek will be too low to permit its use for this purpose.

C. Hydrological Effects

The proposed method of sludge disposal at the Salt Creek site is subsurface soil injection over an area comprising most of the site. During the spring rains of 1975, this area was heavily waterlogged. The EQCC cautions that sludge injection into land which is subject to periodic leaching by rain water, and which abuts major receiving streams, may result in periodic large influxes of nutrients, untreated heavy metals, and other matter into the streams. It should be noted that this creek water is a water source for Bedford, only thirteen miles downstream. These problems are not addressed in the facilities plan.

These possible detrimental hydrological effects may be exacerbated by the location of the Salt Creek site within a 100-year flood plain. Until flood-plain alterations potentially caused by the Lake Monroe dam are known, it would be wise to require that the facility's construction plans include safeguards to prevent discharge, leakage, or leaching of untreated wastes from the plant area into the creeks during periods of high water.

D. Secondary Effects of Unplanned Development in the Lake Monroe Area.

Another major concern of the EQCC is the possible adverse effect on the Lake Monroe area resulting from development in the lake's watershed stimulated by the placement of the treatment facility at Salt Creek. We anticipate this facilitation because, according to Public Law 92-500 development cannot occur without suitable wastewater treatment. While the dollar costs to Bloomington at Dillman Road or

Salt Creek are similar, the cost to LMRWD*is much less if the Bloomington Plant is at Salt Creek. The advantage of this Salt Creek hookup is that several existing sources of effluent will be removed from the lake. This is the main environmental benefit of this arrangement. This is balanced by the possibility that cheaper sewage treatment will permit more rapid development than would otherwise occur. In principle the development of private living structures and even commercial ones, need not lead to the deterioration of the lake region, providing that sufficient planning controls and enforcement procedures are established and maintained. No such planning structures and controls exist in the region at this time. The Lake Monroe Land Suitability Study recently carried out is not intended to guarantee the planning needed in the area although it can serve as background for the development of such a plan. In view of this situation EQCC is evaluating potential environmental effects based on recent and current planning and construction methods.

The EQCC considers the primary functions of Lake Monroe to be 1) flood control water impoundment, 2) a recreational resource, 3) a major source of domestic water for the City of Bloomington and its environs. It is the potential deterioration of these functions of the lake with which we are concerned. In addition, much of the land around the lake presently has an undisturbed, natural quality which is important in and of itself and also as it enhances the recreational value of the whole region.

Development without a regional land use plan and construction practice regulations potentially could detract from the functions listed

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*Lake Monroe Regional Waste District

above in the following ways:

1) Conversion of privately owned natural areas into developments which will decrease the amount of natural landscape for aesthetic, wildlife and recreational use. This effect will be concentrated in certain areas.

2) Improperly controlled construction destroys foliage and ground cover, resulting in erosion, increased sedimentation and potentially decreased water quality.

3) Increased use of motor-driven boats and motor vehicle traffic on land will probably result in increased amounts of oil-based products and heavy metals entering the lake.

4) Motor boat traffic may result in increased shoreline erosion.

5) Unaesthetic construction on and around the lake's shoreline will detract from the natural quality and recreational value of the lake area.

One very important variable which must be considered in evaluating possible development around Lake Monroe is the opinion of those people who use the Lake. Wise (1975) has surveyed opinions of users and found significant expressions in favor of preserving the semi-natural quality of the area. Most users prefer swimming, camping, and boat fishing as recreational activities. A substantial plurality favored fewer condominiums and houses around Lake Monroe than presently exist. Facilities which those interviewed did not desire included motels, sporting goods stores, condominiums, houses, and boat ramps. All but 3% found the forest around the lake attractive. The attribute which people like best is the beauty of the lake. The attributes liked least are the crowding and facilities. EQCC's conclusion about public opinion is that the type of development likely to be facilitated by placement of Bloomington's sewage treatment plant at Lake Monroe (houses, condominiums, commercial) is precisely the type of development which Lake users do not want. Further, such development might destroy those aspects of the Lake environment which the users appreciate the most (attractiveness, forests, fishing) and exacerbate problems which they already perceive (crowding and facilities).

EQCC is concerned that the necessary regional planning does not exist to control such effects on the lake's primary functions as those listed above. We therefore believe that development should not be facilitated by placement of the plant at Salt Creek. We recognize the environmental value of removing present sources of effluent from the lake, but are not certain that this value overweighs the other negative effects which potentially might result.

E. Summary

The Salt Creek site will require a longer and thus more environmentally disruptive outfall sewer than any of the Clear Creek sites. A Clear Creek plant will produce effluent of higher quality than the proposed Salt Creek plant, whose effluent will be outside legal limits shortly after commencement of operation. Hydrological considerations indicate that a Salt Creek plant may periodically cause stream pollution. Finally, the Salt Creek site is more likely than a Clear Creek site to lead to unplanned development in the Lake Monroe area, with all the environmental deterioration this implies. Because the environmental costs of the Salt Creek site are obviously much higher than those of the Dillman Road site, and because the economic costs are similar, the Salt Creek site can be eliminated from further consideration.

IV. Comparative Evaluation of the Clear Creek Sites

Differences among the impacts of the various Clear Creek sites on the physical environment are minor compared with the difference in impacts between any of the Clear Creek sites and the Salt Creek site. The outfall sewer to the Dillman Road site would be a little longer than the force main from the southeast interceptor to the Winston Thomas or South Rogers Street sites, and the outfall sewer to the Ketcham Road site will be a little longer still. On the other hand, if the new plant is not built at the Winston Thomas site, that site can be converted to a park, though the South Rogers site would use part of the present site and decrease the value of a park there. Selection of the Winston Thomas site may lead to better re-use of existing materials. **Thus**, in terms of physical environmental impact, the only clear advantage at this point is that of Dillman Road over Ketcham Road. Given its higher economic costs, also the Ketcham Road site can be eliminated from further consideration.

The major drawback to the present location seems to be the construction disturbances and the possibility of increased odors in the vicinity which is heavily populated, and the possible need to relocate several households. The Dillman Road site is not presently densely populated and for topographic reasons does not seem threatened by nearby settlement. EQCC finds that, while all the Clear Creek sites seem preferable to Salt Creek, we would rank Dillman Road ahead of Winston Thomas/S. Rogers St. primarily for social reasons.

V. The Need for an Environmental Impact Statement

EQCC recommends that if the Salt Creek Site is selected, EPA should definitely prepare an EIS to investigate not only the points made above but also many other specific points concerning possible routes for the outfall sewer, the advisability of sub-surface injection as a means of sludge disposal, and specific treatment plans. The issue most difficult for us, as citizens, to predict and understand about the problem of site selection is the question of secondary impact of development in the Lake Monroe Area. EQCC recommends that, because of the complexity of this problem, major efforts should be made by EPA to predict, evaluate and suggest solutions to these secondary impacts. A list of points needing investigation in an EIS follows this section. Some members of EQCC believe that an EIS might be desireable irrespective of which site is chosen and so points related to both sites are included on the list.

1. Environmental desirability of returning Clear Creek to its pre-Winston Thomas flow level in order to restore the original biota; comparative study of Little Clear Creek biota might be made to determine if change has occurred.

2. Extent of direct destruction of wildlife habitat by outfall sewer construction.

3. Quantitative assessment of Clear Creek siltation which might be caused by sewer construction; effect on Bedford drinking water.

4. Extent of indirect environmental degradation caused by outfall

sewer construction due to activities by the work crew such as driving equipment into and out of right-of-way, parking automobiles, etc.

5. Identification of those areas where blasting must be done and assessment of the impact of the resulting fallout and noise on nearby wildlife habitat and cultural areas, e.g., Cedar Bluffs, Ketcham Road cemetery.

6. Differentiation of sewage treatment alternatives with respect to effluent quality, especially between alternatives 2A and 3A in Facilities Plan; analysis of economic-environmental tradeoffs.

7. Extent to which revegetation is necessary following sewer construction, how soon it must be done, and how likely it is to be successful, given the area's hydrology; differentiation between degrees of erosion expected with and without revegetation.

8. Environmental impact of overland sewer routing, including considerations similar to those given above for creek bed routing. Judgment on the advisability of building alternatives 3, 4, 5, and LMRWD Smithville-Clear Creek force main.

9. Reevaluation of economic-environmental costs of outfall sewer alternatives for Salt Creek site, expecially with respect to alternatives 2 vs. 5A; analysis of environmental tradeoffs of greater overland as opposed to less creek bed routing for alternative 5A; amount of economic difference LMRWD might fund as their share of Little Clear Creek sewer to have a plant on Salt Creek instead of Clear Creek.

10. Description of biota of wildlife habitat to be destroyed at Ketcham Road and Salt Creek sites and determination of its rarity.

11. Measures to be taken to ensure that holding ponds, etc., will not be flooded.

12. Environmental assessment of possible landfill and soil injection sites to determine potential for water pollution due to flooding or leaching after rainfall.

13. Comparisons of degrees of buffering needed and possible for various sites and various treatment and disposal methods to shield local residents and visitors to natural and cultural areas from noise, odor, and ugliness of sewage treatment.

14. Assessment of tradeoffs between biotic-geologic costs and social costs, the latter accruing from #13 above and from forced relocations at some of the sites. (See also #23)

15. Current aesthetic values of undeveloped sites.

16. Comparative analyses of economies of land use for various sewage treatment and sludge disposal alternatives.

17. Size of the work crew required for construction, where they will commute from and what social costs they might impose on the community.

18. Social benefits with respect to reducing unemployment of construction of plant.

19. Comparative analysis of energy and resources required for various site, treatment, and disposal alternatives.

20. Environmental effects of travel over, entry to, and exit from right-of-way by maintenance crews.

21. Precautions that must be taken to prevent the creek from digging through to the sewer at crossing points; effects of these precautions on biota and flow characteristics; impact of altered flow characteristics on downstream creek ecosystem.

22. Impact of possible herbicide use during right-of-way maintenance on environment, both directly on biota and indirectly due to possible water pollution this might cause.

23. Surveys of local residents as to what impact they feel the Winston Thomas plant and its proposed expansion or removal to South Rogers Street has or will have on their lives; income distribution of residents so affected and assessment of their political power.

24. Environmental benefits accruing to Clear Creek sites due to potential recreational uses of Clear Creek resulting from maintaining its present flow level.

25. Possibility that a regional plan should be a prerequisite for selection of the Salt Creek site.

26. Total environmental analysis of the effects of unplanned development around Lake Monroe facilitated by the Salt Creek site, including potential biotic, geologic, and social costs accruing from any destruction of forest, degradation of the water supply, and increase in population

density and potential social gains accruing from economic growth; tradeoff analysis of these costs and gains.

27. Environmental and economic costs and gains accruing from sludge disposal by means of treating it and selling it as fertilizer.

28. Determination of any upper ceiling which geologic restrictions may place on south-planning-area population and deduction of largest sewage treatment design capacity that will ever be needed.

JCR/nan

Acknowledgements

James Chiesa, S.P.E.A. graduate student, has permitted use of portions of an unpublished manuscript as well as volunteering editorial help. The following report was cited in the text:

Wise, Charles. 1975. User preserences of policy alternatives: the case of recreational user attitudes toward development and regulation at Lake Monroe, Indiana. School of Public and Environmental Affairs Occasional Papers, No. 4.

Soil Survey, 1973. Interim Soil Survey, Vol. 2, Information and Interpretation, Bloomington, Indiana. U. S. Department of Agriculture, Soil Conservation Service, Purdue University.

APPENDIX

Brief synopsis of items discussed during Environmental Quality and Conservation Commission meetings which pertain to Lake Monroe, water quality, and the sewage treatment plant.

HISTORY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE
Based on 1972 minutes

May 10 -- reported that Rod Crafts and Barbara Restle would travel to Indianapolis to speak with John Cregor, an attorney who is the foremost leading authority in the country on riparian rights, about the City's power to control development in Lake Monroe. The Water Quality Committee wished to issue a warning about the possibility of Inland Steel encroaching upon Lake Monroe and requested the Commission's support and approval for enlisting the aid of other groups in the effort. A motion was made and approved that The Water Quality Committee should accumulate as much factual information as they can before the next Commission meeting with their suggestions as to what action the Commission can take respecting Lake Monroe.

July 12 -- The resolution on Lake Monroe development was read and David Docauer presented a background report on the resolution. He said that the resolution was a beginning step in seeking protection for Lake Monroe. The vote was unanimous. John Patton directed that the absent members be polled to ensure a majority giving approval.

August 9 -- A motion made that: The Commission request the City of Bloomington to name a representative to sit in on the final hearing of the Department of Natural Resources; to request from Inland Steel's attorney a copy of the plans to be made available as soon as possible; and a representative be named to appear at the hearing of the Stream Pollution Control Board on Tuesday, August 15, 1972. Whitehead offered an amendment asking that Inland Steel give the plans of their development within the drainage basin of Lake Monroe and that they also name a representative to come before the Commission to discuss the development. The motion and amendment were approved unanimously.

October 11 -- Dick Hilliker, Representative of Inland Steel Development Corp., presented maps, gave a report on a proposed development around Lake Monroe and discussed the development proposal with the Commission and the audience. A Water Quality Committee report submitted by Docauer was accepted. Donald Whitehead and David Docauer agreed to write a letter to the Stream Pollution Control Board and the University on behalf of the Commission stating their views on the ISDC's plans.

November 8 -- Ted Najam, Administrative Assistant to the Mayor, read a statement from the Office of the Mayor concerning the proposed Position Paper prepared by David Docauer and Donald Whitehead on land development around Lake Monroe; the present state of Lake Monroe and a projection of its future in relation to presently proposed developments and future developments. The statement basically said that the Commission should not make such statements without making it clear that it is not necessarily the position of the City and "A statement of this kind with such broad ramifications should be made only after there has been broad participation by all those City departments and commissions which have something to contribute." Discussion followed, and some changes were made on the position paper. The paper was approved. It was decided that Don Whitehead would represent the Commission before the Common Council.

December 13 -- Donald Whitehead reported that the Common Council passed a resolution accepting and concurring in the Commission's Position Paper. Bron added that at the end of the discussion a suggestion was made by Council President Charlotte Zietlow for the formation of a body to look into the ecological factors that concern the lake and the long range view. Chairman Patton would contact Zietlow to request that the Commission be included in such a body if it was not already constituted.

SUMMARY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE
Based on 1973 minutes

January 10 -- The Commission's draft statement on the Black and Veatch report was presented. In the discussion that followed, it was brought out that there would be federal funding but the City does not require an impact statement. Dave Rogers(President of the Board of Works) said he worked with the Black and Veatch Report and thought the comments of the statement appropriate. On finding Number two (Monroe Reservoir) he felt the comments were well taken, but said that Black and Veatch were only asked to do a bare bones study so the report does not take into account the impact of increased development. The construction of waste water facilities would of necessity require federal grants, which would in turn require an impact study, though that study would be directed primarily toward alerting the public rather than binding any specific agen cy to a set course of action. Mr. Rogers said also that Lake Monroe Reservoir would not provide all of Bloomington's future water need. The city plans to continue to develop dependencies on Griffey Creek-Bean Blossom, though dependence on Lake Monroe would continue to be very important. He added that the state makes a good profit from the city of Bloomington by providing the water from the Lake Monroe Reservoir and that the state owed the city considerable consideration in protecting the security of that water supply.
Barbara Heise asked if Mr. Rogers thought the tertiary treatment facilities should be funded immediately. He acknowledged the need and said the city would file for both federal and local funds, but he warned that the costs would be astronomical. Mr. Spencer asked whether effluent from the treatment plant was delivered to Salt Creek below the dam, and whether any study had been made on plans to deliver processed water in the same area where the sewage system is proposed. Mr. Rogers said that the sewage plant was in one of the areas which the Public Service Commission had currently given to one of the rural water corporations and that the outflow main that goes down through Clear Creek actually goes through a no man's land where there is currently no allocation of responsibility. Mr. Bron asked about future additional water sources besides Lake Monroe Rogers said that Griffey Creek-Bean Blossom was not delivering the high quality water it could if the treatment system were improved. He expected that once improved, the city could receive good water from it at a price below that the city is paying to the state for water from Lake Monroe. Mr. Bron asked what population was projected by that plan and Mr. Rogers answered that it ought to be done just on the basis of present population because of the high price the city is paying for Lake Monroe water. To meet projected need both systems would have to be improved, and the plant on Lake Monroe doubled. Mr Bron said it was his personal feeling that, in view of the high taxes to be paid by city residents; it was not unreasonable to ask that whatever development occurs be controlled so that it doesn't damage the lake. Mr Rogers answered that he didn't think there was any conflict with that, but he was not sure whether the government had the current ability to control development. Barbara Heise asked if it wasn't true that the city has virtually no control over development. Mr. Rogers responded affirmatively saying the city really could only make hopeful statements.
Mr. Docauer spoke about the Griffey Creek Reservoir saying that it has good quality water because it is well forested, but the quantity is insufficient. He had little personal knowledge of Bean Blossom, but had heard it was very turbid and hard to process. He doubted if it would serve if the population increased. He said some of the mistakes in the Black and Veatch Report had not been corrected. His comments were: 1. That all growth projected in the report until 1980 occurring within Bloomington was unlikely--much should occur outside the city. 2. That more growth would occur in the city than in the county was also unlikely. 3. The overloaded south plant was designed for 7,000,000 gallons whereas before the Commission was told 10,000,000.

4. The tertiary treatment facilities need to be placed now. Sometimes tertiary lagoons cause problems--high algae growth causes secondary pollution. No sure method exists to remove the algae by sedimentation and the city ought to consider this. In response to Barbara Heise's question as to whether tertiary lagoons were the method of tertiary treatment now in use, Mr. Docauer said there were other methods (electrolysis, chemicals) depending on the purpose of the tertiary treatment.
Chairman Patton suggested an amendment to the wording of the statement of the effect that "all future additional water needs must come from Monroe Reservoir" be changed to "and much of the foreseeable future additional water need of Bloomington must come from the Monroe Reservoir." The motion was accepted and the amendment adopted.

February 14 -- George Walkenshaw, of the City's Utilities Department, spoke about the problems facing the City's other sources of water, Lake Lemon and Lake Griffey. He pointed out that the City was never able to utilize fully Lake Lemon water because it has to flow down a creek ten miles before it is collected and repumped to the Griffey Water Treatment Plant, a facility which was never designed to treat a water with a high turbidity content. Thus, in the past year the city has only been able to use water taken directly out of the Griffey Reservoir. He mentioned that water from Lake Monroe was costing the city about three million dollars a day. It would be Black and Veatch's recommendation to expand and remodel the Griffey Water Treatment Plant so that the water from Lake Lemon could be fully utilized. This would involve extensive settling and floculation facilities because of the sludge problem. He knew of no perfect solution to the dewatering of alum plant sludge, but said, the City is presently constructing some pave drying beds from which the sludge could be scraped after it has been dried by mechanical equipment, then hauled off and buried in land fills. Other methods are under investigation. Other problems included storm water entering the South Sanitary Treatment Plant, and the plant is a dry ditch situation allowing little oxidation of the organic material in the stream thereby causing odor. He then spoke on solutions and a discussion followed.

The Water Quality Committee introduced a resolution to support the Lake Shore Protection Bill now in the state legislature. The Bill would give the Natural Resources Commission the right to review all development within two miles of state owned or managed reservoirs. Docauer remarked that the purpose of the Bill was to make the NRC into a kind of Plan Commission for the lake which would examine all aspects of planning. The Stream Pollution Control Board presently hasn't the power to do this and neither does the NRC. Corporation-owned land within the Monroe watershed is about 3300 acres, all but about 600 acres inside the two mile area. The Bill gives the NRC power to make decisions which it previously was not able to make.

March 21 --Barbara Restle of the Water Quality Committee, presented a preliminary report on a sedimentation survey of Lake Monroe. Since the area is undergoing rapid change, it is necessary to start now to obtain accurate records of the sedimentation rate, which is thought by the Army Corp of Engineers to have a worse effect on a reservoir than sewage or industrial pollution. The Corp may not survey Lake Monroe for 4 to 5 years and the only soil surveys of the area now are based on a 1922 study. A recconnaissance study of the Lake is in order. now to determine roughly what the rate might be, especially since the original surveys were made with no projected change in the land use around the reservoir. A motion was made for the Commission "to encourage the City to take cooperative action with the county as soon as possible to get the Corps of Engineers to make a recconnaissance sedimentation study of Lake Monroe at its earliest possible opportunity in view of the probable effects of the proposed developments around the lake."

May 9 -- Barbara Heise reminded the Commission of the position it had taken last year, that in the absence of good regional planning, massive development around Lake Monroe was unwarranted. Since that time, Inland Steel has been given its nearly final approval to build. Heise noted that the county zoning ordinance would be having public hearings during the summer and urged Commissioners to attend these meetings to defend tighter controls for the two mile fringe. Jan Bianchi indicated that a representative of the Army Corps of Engineers had indicated that the Corps may not be favorably disposed to issuing a permit to Inland.

June 13 --A letter from the Army Corps of Engineers said that the Corps planned to resurvey the Lake, completing the other range installations, in 1977. In the meantime a preliminary survey would be conducted and the results would be communicated to the City. The letter added that the Corps did not fear a potential reduction of the lifespan of the lake due to sedimentation even though studies of other reservoirs indicate that initial projections of that rate are incorrect. Bianchi suggested, in light of Senator Bayh's recent disapproval of the Indianapolis Reservoir project, that the Commission could exercise a little more force in pursuit of a survey. More pressure could be brought to bear upon the Corps at least to get a study on track for 1977. Bron argued that 1977 may well be too late because the development around the Lake appears to be iminent. Heise asked what results could be expected from a preliminary survey. In response Barbara Restle, new chairwoman of the Water Quality Committee, indicated that such a survey would probably be quite trivial. A comprehensive survey is quite complex and must give an indication of where the sedimentation is coming from, not just how much deposition there is. Such information would be necessary in order to design sedimentation basins to protect the reservoir from further sedimentation. Responding to a question of the cost of such a study, Fix estimated around $20,000. He thought the Commission should ascertain the estimate cost and then go directly to Washington for the appropriation. Bron agreed that the City has much to lose should it not pursue this course. Patton proposed that the Commission take initial steps to carry out Fix's proposal by seeking a cost estimate.

The Environmental Commission has been asked by the Plan Staff, to appoint a member to attend meetings at Purdue on the ramifications and possible uses of the information gathered by the Skylab experiments over Lake Monroe.

Bianchi reported that Inland Steel had still not accepted the restrictions placed upon them by the Stream Pollution Control Board and were not on the agenda for the June meeting. In another development, the proposed county zoning ordinance has been amended to provide that no development visible from the shores of Lake Monroe would be permitted, and to require drainage and erosion controls around the lake. This amendment will be discussed June 14, and could use the support of all Commissioners. Bron added that the Forest Service had also decided to deny permits to cross Forest Service land with utility pipelines until a regional plan is devised. Heise pointed out that this would have particular significance for Granves-Monroe and Inland Steel.

July 11 -- Assistant City Planner, Stu Reller, and Dr. David Frey reported on the Lake Monroe-Skylab project and its possible ramifications for environmental concerns.

Bianchi reported that the estimated cost of a sedimentation survey of Lake Monroe is $24,000 for a resurvey of the existing ranges, and $20,000 to complete the range installations. The Corps said its preliminary study scheduled for July should give a reasonable indication of the sediment in the project now. In light of Barbara Restle's opinion that it is more important to know where the sediment is coming from, such a preliminary study would probably not help much, added Bianchi. She pointed out that Sen. Bayh sits on the Appropriations Committee and could be contacted for help in this matter.

The initial response from the Mayor's office, she reported, was a willingness to pursue the request in Washington, asking that the appropriations be made now, rather than in 1977.

September 12 -- Ted Najam discussed the letter, sent to Birch Bayh, concerning a sedimentation study of Lake Monroe. He explained that an earlier letter had been sent to the Louisville District Army Corp of Engineers in reference to the study. Their reply was that they could give only a quick visual estimate at this time, but that funds for an in-depth study would not be available until 1977. Sen. Bayh explained that the 1974 appropriations bill for the Corps has already been passed by Congress and therefore it is impossible to amend it for such a large amount. He expressed his desire to work with the City in getting appropriations for this study during the next funding session. This would make the study possible 2 to 3 years earlier than predicted and in this sense he was encouraging.

In reference to the Department of Utilities' proposal to close Lake Lemon as a water supply, Marcia Gelpe replied that the Water Quality Committee has begun to look into the proposal and tactics that could be used to clean up Lake Lemon. They expressed their feeling to the City's Utilities Board. The reasons for closing have to do with estimates of renovating the facility compared to the cost of Lake Monroe, volume of water and the plant. Patton commented that several investigations are taking place, one of which is a sedimentation report and he assumed the decision won't be made until the information is in.

October 10 -- The Water Quality Committee has been studying the problem of spills of raw sewage into Salt Creek from the Nashville Sewage Plant and sent a letter to the County Commissioners of Brown County asking that a joint meeting be set up to discuss the source of the problem as well as possible solutions. The Commission agreed to send a letter to the Brown County Commissioners endorsing the idea of a joint meeting and asking to be kept informed on the progress on solving the problem.

November 14 -- Dennis King presented a report concerning the meeting of the Lake Monroe Regional Waste District Board and City Utilities Service Board and a request of the Water Quality Committee submitted for an additional hearing on an environmental assessment hearing to determine the environmental effects of the regional sewer treatment plant that is going to be constructed by the City Utilities Service Board and of the diversion system that will be put in by the LMRWDB. The Water Quality Committee said that the LMRWDB had not filed any information prior to the meeting in conjucction with regulations that the EPA has stated and therefore did not give the public a 30-day notice to study the information. The outcome of a request that they hold another meeting was a letter which indicated that another meeting would not be held, but they would put some information on file and answer questions, if there are any. A motion was made by the Environmental Commission and approved that a hearing be held at the regular December Environmental Commission meeting with the Utilities Service Board and their engineers answering questions from the Commission and the public. In addition, the LMRWBD and the Monroe County Plan Commission were requested to attend. Barbara Restle stressed the interrelatedness of these two projects in the Water Quality Committee report.

December 12 -- see attached minutes.

HISTORY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE

Based on 1974 minutes

February 13 -- Barbara Restle read the minutes of the last Water Quality monthly meeting. In short, it said there was concern on the part of many members that an environmental impact statement should be requested by the committee that would deal with the effects of the new sewage plant in greater detail. A working subcommittee was formed to study the assessment hearings held by the USB. It was hoped that this subcommittee would reach a conclusion on the course of action the Water Quality Committee should pursue. No questions or comments were added.

Restle presented to the Commission a summary of the considerations from the subcommittee. She said the summary was by no means complete. The two considerations presented were in the areas of population data projections for Monroe County and problems with the treatment plant site and outfall sewer. Patton recommended that these comments, if approved by the Commission, should become part of the December 12th meeting. Restle agreed but added that more considerations than these two are being questioned. Restle stated that, although the population data appears complete in the assessment it is not. Dennis King explained that one of the first considerations to be included in an assessment is a description of the effect of population distribution concentration on any growth that might occur if the project is undertaken. He said that, with that in mind, the subcommittee went through the Infiltration and Inflow Study and the hearing record for the October 25th environmental assessment hearing and the December 12th information meeting to determine what RSH Associates had done in regard to population projections. King said his impression was that the statistics used in the assessment had projections to 1980-1990 based on the census of 1950-1960. If it is based on these years there would be no influence from the lake on the extraurban area because the lake was not constructed until 1963. King said that the alternatives to the temporary plant site were not mentioned with regards to growth in different volumes and directions. He said the Water Quality Committee is recommending further study. Heise asked if the Water Quality Committee was asking for an environmental impact statement. King replied that at this time they are not asking for an environmental impact statement but only trying to point out subjects that are not adequately investigated. Patton summed up King's comments by saying that the population projection studies are not adequate and the effect of the waste water disposal plant on changes in population have not been assessed at all. King's final comment pointed out that if the population projections have not been adequately looked into one can not design capacity of a plant properly. A copy of these questions will be sent to the USB and EPA administrators. The Commission voted unanimously to forward them.

Jim Ferro reported that at the last monthly meeting of the Water Quality committee another working group was formed composed of Jim Pres, David Docauer, and himself. This working group will investigate the effects of construction activities around Lake Monroe with regards to water run-off. The second major project the working group is considering is one concerning Lake Lemon. This would involve sampling the shoreling during a rainy period to measure runoff.

April 10 -- Jim Ferro said the water sampling project which is being planned to test the quality of the run-off in the Lake Monroe watershed is being organized and should be underway soon.

September 11 -- An ad hoc committee consisting of Rick Peoples, Dave Parkhurst, Rick Darby, and Barbara Heise agreed to study the USB report on the Long Range Plan Water Supply and Distribution Facilities for Bloomington, IN.

Rick Darby gave his report on Lake Monroe. This report concerned the legal standing; how can a reservoir outside of the city boundaries be controlled and what is the relationship of the Commission to that lake, and whether there is anything the Commission can look into other than water quality itself.

September 25 -- Barbara Restle said that interests in the Water Quality Committee are too broad. There are legal problems, bacteriological problems, limnological problems, sedimentary problems, and more. The committee needs to form subcommittees and she asked for suggestions on restructuring.

November 13 -- Rick Darby gave a report on Lake Monroe. He said that Lake Monroe is a large interest requiring tremendous work. There is no way one person can provide the Commission with enough information for the Commission to feel it is in control with the situation. He has therefore arranged with Professor White in the Law School for students to receive credit for participating in a project designed to prepare a paper or pamphlet which would adequately describe the jurisdiction of various governmental bodies over Lake Monroe, interaction and jurisdiction between this commission and the City, of Bloomington in those various bodies and the rights generally given to individuals in Indiana in the Environmental field. Rick feels with this help, by the first of the year, a comprehensive and fairly clear statement of exactly where the Commission stands can be provided. He then went on to state the legal proceedure the Commission would have to go through if it was to take action and suggestions the Commission should consider. Walter Bron asked if Rick had a specific group in mind other than Water Quality. Rick said no. Rick Peoples gave a report on the status of the Water Quality Committee. The first meeting was held. Only four people showed up but only one was interested in participation.

BLOOMINGTON

CITY OF BLOOMINGTON
PO BOX 100, MUNICIPAL BLDG., BLOOMINGTON, INDIANA 47401

Environmental Commission

June 5, 1975

Mr. Harlan D. Hirt
Chief, Planning Branch
United States Environmental
Protection Agency, Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

The Environmental Quality and Conservation Commission of Bloomington would like to ammend its "Recommendations of the Environmental Quality and Conservation Commission on the Siting of the Proposed Bloomington Sewage Treatment Facilities." The report has been sent to you within the past week.

The amendment takes the form of clarification of some of the points made in the original "Recommendations" and additional points which we raise in the hope that they will be addressed in the forthcoming Environmental Impact Statement. These additional items stem primarily from the discussions which occurred during the Environmental Assessment Hearing held in Bloomington on May 29.

The amendment is enclosed.

Sincerely yours,

W. E. Bron, Chairman
Bloomington Environmental Quality
and Conservation Commission

WEB/lk

Indiana's Cultural, Educational and Recreational Center

Amendment to the "Recommendations of the Environmental Quality and Conservation Commission (EQCC) on the Siting of the Proposed Bloomington Sewage Treatment Facilities"

1. Comparison of the Effluent Quality Effects between the Salt Creek Site and Any of the Clear Creek Sites.

   Discussion during the May 29, 1975 Environmental Assessment Hearing brought out the point that current requirements on effluent, based on the dilution capacity of the receiving stream, may not (or may) be changed in the future to meet the 1983 goals stated in Public Law 92-500. If the requirements are not increased, then clearly the one-stage Salt Creek plant could continue to be in compliance with the legal requirements. In any event, however, as regards full cost effectiveness, a Clear Creek plant is more cost effective than the Salt Creek plant, because the former would discharge a higher quality effluent for the same cost. Moreover, with regard to future standards, a Clear Creek plant would discharge an effluent more clearly in the spirit of Public Law 92-500 than would the Salt Creek plant.

2. The EQCC recommends that every effort be made to consider construction of a plant at the Dillman Road site without relocating Clear Creek. An amount of about $1.3 million has been estimated by Black and Veatch for the cost of relocating the creek. An additional $1 million appears to have been included for aligning the plant to fit the site after relocation of the creek. It appears to the EQCC that for

$2.3 million (and probably for considerably less), sewer links can be built between components of the facility which would need to be located on either side of the creek. We request that the EIS consider the environmental consequences of relocating the creek compared with the construction of sewer links, and also the relative cost effectiveness of these alternatives.

3. At the Environmental Assessment Hearing, Black and Veatch claimed that the need for vacuum drying of sludge at the Dillman Road site results from the lack of two to three level acres of land needed to build drying beds. The relative additional cost for vacuum drying over drying beds is projected to be $1 million (projected worth). This additional expenditure is assessed only on the Dillman Road site. A study of a geodetic map of the site suggests that the required two to three acres of land are available, even if the Black and Veatch layout is adhered to. In any event, it appears to the EQCC that the required acreage can be constructed for considerably less than the incremental $1 million. The EQCC requests that this cost differential be investigated.

4. The EQCC questions the need for an additional amount of $100,000 yearly attached by Black and Veatch to the labor costs at any of the Clear Creek sites compared to the Salt Creek site. The only explanation of this amount given by Black and Veatch to date is that the Clear Creek sites do not require more personnel but, rather, higher quality personnel. Since Black and Veatch has stated that the complexity of operation is the same at all sites, the EQCC fails to

understand the basis for this incremental assessment against the Clear Creek sites. The EQCC requests that this cost differential also be investigated.

ENVIRONMENTAL PROTECTION AGENCY
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FILE NO.

RECOMMENDATIONS OF THE ENVIRONMENTAL QUALITY AND CONSERVATION COMMISSION ON THE SITING OF THE PROPOSED BLOOMINGTON SEWAGE TREATMENT FACILITIES

RECOMMENDATIONS OF THE ENVIRONMENTAL QUALITY AND CONSERVATION COMMISSION ON THE SITING OF THE PROPOSED BLOOMINGTON SEWAGE TREATMENT FACILITIES

1. General Background

Almost since its inception during the spring of 1972 the Environmental Quality and Conservation Commission (EQCC) has been studying the environmental aspects of the placement of a new waste-water treatment facility in southern Bloomington. This is demonstrated by the record of the EQCC meetings, which is summarized in the Appendix. The EQCC has discussed the siting of the facilities during many civic meetings, has supported several pertinent studies, and has participated in studies carried out by others. We have presented recommendations and relevant information to the citizens of Bloomington, to the Common Council, to various members of the City Administration, and to State and Federal officials. Relying on these experiences and the understanding we have gained from them, we present this report as our analysis of the environmental factors associated with the siting of the proposed facilities.

From an environmental perspective, there are two major siting options: the proposed Salt Creek site and the alternative sites on upper Clear Creek. Possible alternative sites mentioned to date include the present Winston Thomas site and sites on South Rogers Street, on Dillman Road, and on Ketcham Road.

II. Recommendations

Based on their community involvement referred to above and on their professional expertise in such areas as physics, chemistry, ecology, and soil science, the members of the EQCC have unanimously concluded that all of the Clear Creek sites are environmentally preferable to the Salt Creek site. Of the Clear Creek sites, the EQCC believes that the total environmental impact of construction and operation at the Dillman Road site will be the least. Therefore, the EQCC recommends that the treatment facility be placed at the Dillman Road site. This report will present our reasons for this recommendation; first, the environmental issues differentiating all of the Clear Creek sites from Salt Creek; second, the environmental and social issues which differentiate Dillman Road from Winston-Thomas and South Rogers St. There are four main reasons for selection of a Clear Creek Site:

a. The terrestrial and aquatic destruction involved in running the outfall sewer to Salt Creek will be avoided.

b. The level of effluent quality from the Clear Creek sites will be greater.

c. The Salt Creek site is within the floodplain of Salt Creek, directly below the spillway at the reservoir and located on a soil type known to be subject to waterlogging. (See Soil Survey)

d. The possibility of adverse secondary effects of facilitated development at Lake Monroe because of placement at Salt Creek will be less severe.

The primary considerations differentiating Dillman Road from Winston Thomas/St. Rogers St. are the adverse aesthetic impact of a wastewater treatment facility placed in the more densely populated areas and the social impact of relocation of several families living in a trailer park on the proposed site.

III. Comparison of the Environmental Effects of Clear Creek and Salt Creek Siting

A. Outfall Sewer Effects

Locating the waste-water treatment plant at the distant Salt Creek site requires a long outfall sewer. There are five alternative sewer routes from Bloomington to that site:

(1) under Clear Creek;

(2) along Clear Creek, but higher upon the banks and slicing across the creek's bends;

(3) as in (2), but using a force main to cut across the broad westerly bend of the creek;

(4) along Clear Creek to the Ketcham Road area, then across the hills via a force main to lower Little Clear Creek, then south along Little Clear Creek and Clear Creek;

(5) as in (4), but to upper Little Clear Creek.

The proposed outfall sewers to the Ketcham Road and Dillman Road sites follow route (2) above, but for much shorter distances. Both the South Rogers Street and Winston Thomas sites would require 9000 ft. force mains running up the Clear Creek bed from the proposed southeast interceptor sewer. It should also be noted that, should the Lake Monroe Regional Waste District decide to have its wastewater treated at a Bloomington Clear Creek facility, a force main running overland from

from Smithville to the Clear Creek bed will have to be built.

Outfall sewer construction and maintenance will have detrimental environmental effects; the longer the sewer is, the worse these effects will be. These effects can result from earth-moving during construction and may also include permanent environmental damage caused by right-of-way clearance and maintenance. All of these effects are magnified by the proximity of a natural area, Cedar Bluffs. Following is a more detailed consideration of these factors.

The right-of-way for construction of sewer alternative (2), which is the one recommended by Black & Veatch, is 100 feet wide and about 60,000 feet long. An area of six million square feet will thus be subjected to physical abuse. A trench averaging twelve feet deep will be dug down the length of this right-of-way. Much of the 4.3 million cubic feet of earth that will have to be removed is limestone, which will have to be blasted out. Some of this spoil will be bulldozed and graded to level the right-of-way for maintenance access. It is rather difficult to believe that bulldozing and blasting on this scale could be done with an eye to "limiting environmental disruption" (Black & Veatch, p. X-16). It is more reasonable to believe that construction activity will result in the destruction of much terrestrial and aquatic wildlife habitat, in addition to impairing the stream's aesthetic value.

Despite the promise to grade and reseed "as soon as practicable," it may work out that, considering the frequency of rain and flash-flooding in the area, erosion may set in before vegetative cover does. In the case of alternative (3), erosion may also result from unrevegetated sewer line easements in the hills above the creek. In any case, the resultant siltation of the stream could have an effect on the aquatic biota more permanent that that caused by sewer construction itself.

The EQCC also has reservations about the effects of the twenty-odd creek crossings proposed under alternatives (1) and (2). The provisions for keeping the line from being dug up by the action of the stream are not described in the Black & Veatch report. This makes it impossible to comment on them specifically except to hypothesize that there may be permanent changes in the substrate of the creek which could affect stream biota, flow characteristics, and aesthetics adversely.

Though specific techniques for right-of-way maintenance have not been described by Black & Veatch, usual procedures involve defoliation with herbicides. This would constitute a chronic perturbation to the immediate and neighboring wildlife habitat as well as a possible source of pollution from runoff.

Another problem is the proximity of the Cedar Bluffs area to the Clear Creek sewer route. Sewer construction and maintenance could affect the integrity of this area through the resultant noise, dust, and impairment. While the sewer does not pass through the area, alternatives place the line just across the creek from it. On the basis of the above considerations, the EQCC recommends that the important potential negative environmental effects of the outfall sewer be minimized by minimizing the length of the sewer, subject to constraints described below.

B. Effluent Quality Effects

The Salt Creek facility is to be a one-stage plant, while current state water quality standards require that a Clear Creek plant, because of the low dilution capacity of the receiving stream, be a two-stage plant. A one-stage plant is somewhat more susceptible to rapid changes in plant variables such as water volume than a two-stage plant. Rapid changes in water volume do occur in the Bloomington area during the summer. It is conceivable that at that time a one-stage plant could discharge improperly treated effluent.

More importantly, however, a one-stage plant will be unable to discharge effluent of a quality high enough to meet the standards currently required for 1983 by Public Law 92-500. Yet the Black & Veatch study which judges the cost effectiveness of the Salt Creek and Dillman Road sites to be similar assumes a one-stage plant at the Salt Creek site. The EQCC questions the rationale behind a twenty-year cost effectiveness study predicated on water quality standards that will be superseded by more stringent ones after only five years. Clearly, with respect to present water quality standards, a Dillman Road plant would be more cost effective than a Salt Creek plant, because the former would discharge a higher quality effluent for the same cost; with respect to future standards, a cost effectiveness study would have to consider fines the City might have to pay due to the emission of an illegal effluent by a Salt Creek plant. The EQCC concludes that, environmentally, and legally, a two-stage plant is better than a one-stage plant and that, economically, a two-stage plant at Dillman Road is better than a two-stage plant at Salt Creek.

An added benefit of a Clear Creek site with the relatively clean effluent it is required to discharge is the potential recreational use of Clear Creek as a canoe stream. Such areas are not abundant around Bloomington. If the Salt Creek site is chosen, the flow in Clear Creek will be too low to permit its use for this purpose.

C. Hydrological Effects

The proposed method of sludge disposal at the Salt Creek site is subsurface soil injection over an area comprising most of the site. During the spring rains of 1975, this area was heavily waterlogged. The EQCC cautions that sludge injection into land which is subject to periodic leaching by rain water, and which abuts major receiving streams, may result in periodic large influxes of nutrients, untreated heavy metals, and other matter into the streams. It should be noted that this creek water is a water source for Bedford, only thirteen miles downstream. These problems are not addressed in the facilities plan.

These possible detrimental hydrological effects may be exacerbated by the location of the Salt Creek site within a 100-year flood plain. Until flood-plain alterations potentially caused by the Lake Monroe dam are known, it would be wise to require that the facility's construction plans include safeguards to prevent discharge, leakage, or leaching of untreated wastes from the plant area into the creeks during periods of high water.

D. Secondary Effects of Unplanned Development in the Lake Monroe Area.

Another major concern of the EQCC is the possible adverse effect on the Lake Monroe area resulting from development in the lake's watershed stimulated by the placement of the treatment facility at Salt Creek. We anticipate this facilitation because, according to Public Law 92-500 development cannot occur without suitable wastewater treatment. While the dollar costs to Bloomington at Dillman Road or

Salt Creek are similar, the cost to LMRWD*is much less if the Bloomington Plant is at Salt Creek. The advantage of this Salt Creek hookup is that several existing sources of effluent will be removed from the lake. This is the main environmental benefit of this arrangement. This is balanced by the possibility that cheaper sewage treatment will permit more rapid development than would otherwise occur. In principle the development of private living structures and even commercial ones, need not lead to the deterioration of the lake region, providing that sufficient planning controls and enforcement procedures are established and maintained. No such planning structures and controls exist in the region at this time. The Lake Monroe Land Suitability Study recently carried out is not intended to guarantee the planning needed in the area although it can serve as background for the development of such a plan. In view of this situation EQCC is evaluating potential environmental effects based on recent and current planning and construction methods.

The EQCC considers the primary functions of Lake Monroe to be 1) flood control water impoundment, 2) a recreational resource, 3) a major source of domestic water for the City of Bloomington and its environs. It is the potential deterioration of these functions of the lake with which we are concerned. In addition, much of the land around the lake presently has an undisturbed, natural quality which is important in and of itself and also as it enhances the recreational value of the whole region.

Development without a regional land use plan and construction practice regulations potentially could detract from the functions listed

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*Lake Monroe Regional Waste District

above in the following ways:

1) Conversion of privately owned natural areas into developments which will decrease the amount of natural landscape for aesthetic, wildlife and recreational use. This effect will be concentrated in certain areas.

2) Improperly controlled construction destroys foliage and ground cover, resulting in erosion, increased sedimentation and potentially decreased water quality.

3) Increased use of motor-driven boats and motor vehicle traffic on land will probably result in increased amounts of oil-based products and heavy metals entering the lake.

4) Motor boat traffic may result in increased shoreline erosion.

5) Unaesthetic construction on and around the lake's shoreline will detract from the natural quality and recreational value of the lake area.

One very important variable which must be considered in evaluating possible development around Lake Monroe is the opinion of those people who use the Lake. Wise (1975) has surveyed opinions of users and found significant expressions in favor of preserving the semi-natural quality of the area. Most users prefer swimming, camping, and boat fishing as recreational activities. A substantial plurality favored fewer condominiums and houses around Lake Monroe than presently exist. Facilities which those interviewed did not desire included motels, sporting goods stores, condominiums, houses, and boat ramps. All but 3% found the forest around the lake attractive. The attribute which people like best is the beauty of the lake. The attributes liked least are the crowding and facilities. EQCC's conclusion about public opinion is that the type of development likely to be facilitated by placement of Bloomington's sewage treatment plant at Lake Monroe (houses, condominiums, commercial) is precisely the type of development which Lake users do not want. Further, such development might destroy those aspects of the Lake environment which the users appreciate the most (attractiveness, forests, fishing) and exacerbate problems which they already perceive (crowding and facilities).

EQCC is concerned that the necessary regional planning does not exist to control such effects on the lake's primary functions as those listed above. We therefore believe that development should not be facilitated by placement of the plant at Salt Creek. We recognize the environmental value of removing present sources of effluent from the lake, but are not certain that this value overweighs the other negative effects which potentially might result.

E. Summary

The Salt Creek site will require a longer and thus more environmentally disruptive outfall sewer than any of the Clear Creek sites. A Clear Creek plant will produce effluent of higher quality than the proposed Salt Creek plant, whose effluent will be outside legal limits shortly after commencement of operation. Hydrological considerations indicate that a Salt Creek plant may periodically cause stream pollution. Finally, the Salt Creek site is more likely than a Clear Creek site to lead to unplanned development in the Lake Monroe area, with all the environmental deterioration this implies. Because the environmental costs of the Salt Creek site are obviously much higher than those of the Dillman Road site, and because the economic costs are similar, the Salt Creek site can be eliminated from further consideration.

IV. Comparative Evaluation of the Clear Creek Sites

Differences among the impacts of the various Clear Creek sites on the physical environment are minor compared with the difference in impacts between any of the Clear Creek sites and the Salt Creek site. The outfall sewer to the Dillman Road site would be a little longer than the force main from the southeast interceptor to the Winston Thomas or South Rogers Street sites, and the outfall sewer to the Ketcham Road site will be a little longer still. On the other hand, if the new plant is not built at the Winston Thomas site, that site can be converted to a park, though the South Rogers site would use part of the present site and decrease the value of a park there. Selection of the Winston Thomas site may lead to better re-use of existing materials. Thus, in terms of physical environmental impact, the only clear advantage at this point is that of Dillman Road over Ketcham Road. Given its higher economic costs, also the Ketcham Road site can be eliminated from further consideration.

The major drawback to the present location seems to be the construction disturbances and the possibility of increased odors in the vicinity which is heavily populated, and the possible need to relocate several households. The Dillman Road site is not presently densely populated and for topographic reasons does not seem threatened by nearby settlement. EQCC finds that, while all the Clear Creek sites seem preferable to Salt Creek, we would rank Dillman Road ahead of Winston Thomas/S. Rogers St. primarily for social reasons.

V. The Need for an Environmental Impact Statement

EQCC recommends that if the Salt Creek Site is selected, EPA should definitely prepare an EIS to investigate not only the points made above but also many other specific points concerning possible routes for the outfall sewer, the advisability of sub-surface injection as a means of sludge disposal, and specific treatment plans. The issue most difficult for us, as citizens, to predict and understand about the problem of site selection is the question of secondary impact of development in the Lake Monroe Area. EQCC recommends that, because of the complexity of this problem, major efforts should be made by EPA to predict, evaluate and suggest solutions to these secondary impacts. A list of points needing investigation in an EIS follows this section. Some members of EQCC believe that an EIS might be desireable irrespective of which site is chosen and so points related to both sites are included on the list.

1. Environmental desirability of returning Clear Creek to its pre-Winston Thomas flow level in order to restore the original biota; comparative study of Little Clear Creek biota might be made to determine if change has occurred.

2. Extent of direct destruction of wildlife habitat by outfall sewer construction.

3. Quantitative assessment of Clear Creek siltation which might be caused by sewer construction; effect on Bedford drinking water.

4. Extent of indirect environmental degradation caused by outfall

sewer construction due to activities by the work crew such as driving equipment into and out of right-of-way, parking automobiles, etc.

5. Identification of those areas where blasting must be done and assessment of the impact of the resulting fallout and noise on nearby wildlife habitat and cultural areas, e.g., Cedar Bluffs, Ketcham Road cemetery.

6. Differentiation of sewage treatment alternatives with respect to effluent quality, especially between alternatives 2A and 3A in Facilities Plan; analysis of economic-environmental tradeoffs.

7. Extent to which revegetation is necessary following sewer construction, how soon it must be done, and how likely it is to be successful, given the area's hydrology; differentiation between degrees of erosion expected with and without revegetation.

8. Environmental impact of overland sewer routing, including considerations similar to those given above for creek bed routing. Judgment on the advisability of building alternatives 3, 4, 5, and LMRWD Smithville-Clear Creek force main.

9. Reevaluation of economic-environmental costs of outfall sewer alternatives for Salt Creek site, expecially with respect to alternatives 2 vs. 5A; analysis of environmental tradeoffs of greater overland as opposed to less creek bed routing for alternative 5A; amount of economic difference LMRWD might fund as their share of Little Clear Creek sewer to have a plant on Salt Creek instead of Clear Creek.

10. Description of biota of wildlife habitat to be destroyed at Ketcham Road and Salt Creek sites and determination of its rarity.

11. Measures to be taken to ensure that holding ponds, etc., will not be flooded.

12. Environmental assessment of possible landfill and soil injection sites to determine potential for water pollution due to flooding or leaching after rainfall.

13. Comparisons of degrees of buffering needed and possible for various sites and various treatment and disposal methods to shield local residents and visitors to natural and cultural areas from noise, odor, and ugliness of sewage treatment.

14. Assessment of tradeoffs between biotic-geologic costs and social costs, the latter accruing from #13 above and from forced relocations at some of the sites. (See also #23)

15. Current aesthetic values of undeveloped sites.

16. Comparative analyses of economies of land use for various sewage treatment and sludge disposal alternatives.

17. Size of the work crew required for construction, where they will commute from and what social costs they might impose on the community.

18. Social benefits with respect to reducing unemployment of construction of plant.

19. Comparative analysis of energy and resources required for various site, treatment, and disposal alternatives.

20. Environmental effects of travel over, entry to, and exit from right-of-way by maintenance crews.

21. Precautions that must be taken to prevent the creek from digging through to the sewer at crossing points; effects of these precautions on biota and flow characteristics; impact of altered flow characteristics on downstream creek ecosystem.

22. Impact of possible herbicide use during right-of-way maintenance on environment, both directly on biota and indirectly due to possible water pollution this might cause.

23. Surveys of local residents as to what impact they feel the Winston Thomas plant and its proposed expansion or removal to South Rogers Street has or will have on their lives; income distribution of residents so affected and assessment of their political power.

24. Environmental benefits accruing to Clear Creek sites due to potential recreational uses of Clear Creek resulting from maintaining its present flow level.

25. Possibility that a regional plan should be a prerequisite for selection of the Salt Creek site.

26. Total environmental analysis of the effects of unplanned development around Lake Monroe facilitated by the Salt Creek site, including potential biotic, geologic, and social costs accruing from any destruction of forest, degradation of the water supply, and increase in population

density and potential social gains accruing from economic growth; tradeoff analysis of these costs and gains.

27. Environmental and economic costs and gains accruing from sludge disposal by means of treating it and selling it as fertilizer.

28. Determination of any upper ceiling which geologic restrictions may place on south-planning-area population and deduction of largest sewage treatment design capacity that will ever be needed.

JCR/nan

Acknowledgements

James Chiesa, S.P.E.A. graduate student, has permitted use of portions of an unpublished manuscript as well as volunteering editorial help. The following report was cited in the text:

Wise, Charles. 1975. User preserences of policy alternatives: the case of recreational user attitudes toward development and regulation at Lake Monroe, Indiana. School of Public and Environmental Affairs Occasional Papers, No. 4.

Soil Survey, 1973. Interim Soil Survey, Vol. 2, Information and Interpretation, Bloomington, Indiana. U. S. Department of Agriculture, Soil Conservation Service, Purdue University.

APPENDIX

Brief synopsis of items discussed during Environmental Quality and Conservation Commission meetings which pertain to Lake Monroe, water quality, and the sewage treatment plant.

HISTORY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE
Based on 1972 minutes

May 10 -- reported that Rod Crafts and Barbara Restle would travel to Indianapolis to speak with John Cregor, an attorney who is the foremost leading authority in the country on riparian rights, about the City's power to control development in Lake Monroe. The Water Quality Committee wished to issue a warning about the possibility of Inland Steel encroaching upon Lake Monroe and requested the Commission's support and approval for enlisting the aid of other groups in the effort. A motion was made and approved that The Water Quality Committee should accumulate as much factual information as they can before the next Commission meeting with their suggestions as to what action the Commission can take respecting Lake Monroe.

July 12 -- The resolution on Lake Monroe development was read and David Docauer presented a background report on the resolution. He said that the resolution was a beginning step in seeking protection for Lake Monroe. The vote was unanimous. John Patton directed that the absent members be polled to ensure a majority giving approval.

August 9 -- A motion made that: The Commission request the City of Bloomington to name a representative to sit in on the final hearing of the Department of Natural Resources; to request from Inland Steel's attorney a copy of the plans to be made available as soon as possible; and a representative be named to appear at the hearing of the Stream Pollution Control Board on Tuesday, August 15, 1972. Whitehead offered an amendment asking that Inland Steel give the plans of their development within the drainage basin of Lake Monroe and that they also name a representative to come before the Commission to discuss the development. The motion and amendment were approved unanimously.

October 11 -- Dick Hilliker, Representative of Inland Steel Development Corp., presented maps, gave a report on a proposed development around Lake Monroe and discussed the development proposal with the Commission and the audience. A Water Quality Committee report submitted by Docauer was accepted. Donald Whitehead and David Docauer agreed to write a letter to the Stream Pollution Control Board and the University on behalf of the Commission stating their views on the ISDC's plans.

November 8 -- Ted Najam, Administrative Assistant to the Mayor, read a statement from the Office of the Mayor concerning the proposed Position Paper prepared by David Docauer and Donald Whitehead on land development around Lake Monroe; the present state of Lake Monroe and a projection of its future in relation to presently proposed developments and future developments. The statement basically said that the Commission should not make such statements without making it clear that it is not necessarily the position of the City and "A statement of this kind with such broad ramifications should be made only after there has been broad participation by all those City departments and commissions which have something to contribute." Discussion followed, and some changes were made on the position paper. The paper was approved. It was decided that Don Whitehead would represent the Commission before the Common Council.

December 13 -- Donald Whitehead reported that the Common Council passed a resolution accepting and concurring in the Commission's Position Paper. Bron added that at the end of the discussion a suggestion was made by Council President Charlotte Zietlow for the formation of a body to look into the ecological factors that concern the lake and the long range view. Chairman Patton would contact Zietlow to request that the Commission be included in such a body if it was not already constituted.

SUMMARY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE
Based on 1973 minutes

January 10 -- The Commission's draft statement on the Black and Veatch report was presented. In the discussion that followed, it was brought out that there would be federal funding but the City does not require an impact statement. Dave Rogers(President of the Board of Works) said he worked with the Black and Veatch Report and thought the comments of the statement appropriate. On finding Number two (Monroe Reservoir) he felt the comments were well taken, but said that Black and Veatch were only asked to do a bare bones study so the report does not take into account the impact of increased development. The construction of waste water facilities would of necessity require federal grants, which would in turn require an impact study, though that study would be directed primarily toward alerting the public rather than binding any specific agen cy to a set course of action. Mr. Rogers said also that Lake Monroe Reservoir would not provide all of Bloomington's future water need. The city plans to continue to develop dependencies on Griffey Creek-Bean Blossom, though dependence on Lake Monroe would continue to be very important. He added that the state makes a good profit from the city of Bloomington by providing the water from the Lake Monroe Reservoir and that the state owed the city considerable consideration in protecting the security of that water supply.
Barbara Heise asked if Mr. Rogers thought the tertiary treatment facilities should be funded immediately. He acknowledged the need and said the city would file for both federal and local funds, but he warned that the costs would be astronomical. Mr. Spencer asked whether effluent from the treatment plant was delivered to Salt Creek below the dam, and whether any study had been made on plans to deliver processed water in the same area where the sewage system is proposed. Mr. Rogers said that the sewage plant was in one of the areas which the Public Service Commission had currently given to one of the rural water corporations and that the outflow main that goes down through Clear Creek actually goes through a no man's land where there is currently no allocation of responsibility. Mr. Bron asked about future additional water sources besides Lake Monroe Rogers said that Griffey Creek-Bean Blossom was not delivering the high quality water it could if the treatment system were improved. He expected that once improved, the city could receive good water from it at a price below that the city is paying to the state for water from Lake Monroe. Mr. Bron asked what population was projected by that plan and Mr. Rogers answered that it ought to be done just on the basis of present population because of the high price the city is paying for Lake Monroe water. To meet projected need both systems would have to be improved, and the plant on Lake Monroe doubled. Mr Bron said it was his personal feeling that, in view of the high taxes to be paid by city residents; it was not unreasonable to ask that whatever development occurs be controlled so that it doesn't damage the lake. Mr Rogers answered that he didn't think there was any conflict with that, but he was not sure whether the government had the current ability to control development. Barbara Heise asked if it wasn't true that the city has virtually no control over development. Mr. Rogers responded affirmatively saying the city really could only make hopeful statements.
Mr. Docauer spoke about the Griffey Creek Reservoir saying that it has good quality water because it is well forested, but the quantity is insufficient. He had little personal knowledge of Bean Blossom, but had heard it was very turbid and hard to process. He doubted if it would serve if the population increased. He said some of the mistakes in the Black and Veatch Report had not been corrected. His comments were: I. That all growth projected in the report until 1980 occurring within Bloomington was unlikely--much should occur outside the city. 2. That more growth would occur in the city than in the county was also unlikely. 3. The overloaded south plant was designed for 7,000,000 gallons whereas before the Commission was told 10,000,000.

4. The tertiary treatment facilities need to be placed now. Sometimes tertiary lagoons cause problems--high algae growth causes secondary pollution. No sure method exists to remove the algae by sedimentation and the city ought to consider this. In response to Barbara Heise's question as to whether tertiary lagoons were the method of tertiary treatment now in use, Mr. Docauer said there were other methods (electrolysis, chemicals) depending on the purpose of the tertiary treatment.
Chairman Patton suggested an amendment to the wording of the statement of the effect that "all future additional water needs must come from Monroe Reservoir" be changed to "and much of the foreseeable future additional water need of Bloomington must come from the Monroe Reservoir." The motion was accepted and the amendment adopted.

February 14 -- George Walkenshaw, of the City's Utilities Department, spoke about the problems facing the City's other sources of water, Lake Lemon and Lake Griffey. He pointed out that the City was never able to utilize fully Lake Lemon water because it has to flow down a creek ten miles before it is collected and repumped to the Griffey Water Treatment Plant, a facility which was never designed to treat a water with a high turbidity content. Thus, in the past year the city has only been able to use water taken directly out of the Griffey Reservoir. He mentioned that water from Lake Monroe was costing the city about three million dollars a day. It would be Black and Veatch's recommendation to expand and remodel the Griffey Water Treatment Plant so that the water from Lake Lemon could be fully utilized. This would involve extensive settling and floculation facilities because of the sludge problem. He knew of no perfect solution to the dewatering of alum plant sludge, but said, the City is presently constructing some pave drying beds from which the sludge could be scraped after it has been dried by mechanical equipment, then hauled off and buried in land fills. Other methods are under investigation. Other problems included storm water entering the South Sanitary Treatment Plant, and the plant is a dry ditch situation allowing little oxidation of the organic material in the stream thereby causing odor. He then spoke on solutions and a discussion followed.

The Water Quality Committee introduced a resolution to support the Lake Shore Protection Bill now in the state legislature. The Bill would give the Natural Resources Commission the right to review all development within two miles of state owned or managed reservoirs. Docauer remarked that the purpose of the Bill was to make the NRC into a kind of Plan Commission for the lake which would examine all aspects of planning. The Stream Pollution Control Board presently hasn't the power to do this and neither does the NRC. Corporation-owned land within the Monroe watershed is about 3300 acres, all but about 600 acres inside the two mile area. The Bill gives the NRC power to make decisions which it previously was not able to make.

March 21 --Barbara Restle of the Water Quality Committee, presented a preliminary report on a sedimentation survey of Lake Monroe. Since the area is undergoing rapid change, it is necessary to start now to obtain accurate records of the sedimentation rate, which is thought by the Army Corp of Engineers to have a worse effect on a reservoir than sewage or industrial pollution. The Corp may not survey Lake Monroe for 4 to 5 years and the only soil surveys of the area now are based on a 1922 study. A recconnaissance study of the Lake is in order. now to determine roughly what the rate might be, especially since the original surveys were made with no projected change in the land use around the reservoir. A motion was made for the Commission "to encourage the City to take cooperative action with the county as soon as possible to get the Corps of Engineers to make a recconnaissance sedimentation study of Lake Monroe at its earliest possible opportunity in view of the probable effects of the proposed developments around the lake."

May 9 -- Barbara Heise reminded the Commission of the position it had taken last year, that in the absence of good regional planning, massive development around Lake Monroe was unwarranted. Since that time, Inland Steel has been given its nearly final approval to build. Heise noted that the county zoning ordinance would be having public hearings during the summer and urged Commissioners to attend these meetings to defend tighter controls for the two mile fringe. Jan Bianchi indicated that a representative of the Army Corps of Engineers had indicated that the Corps may not be favorably disposed to issuing a permit to Inland.

June 13 --A letter from the Army Corps of Engineers said that the Corps planned to resurvey the Lake, completing the other range installations, in 1977. In the meantime a preliminary survey would be conducted and the results would be communicated to the City. The letter added that the Corps did not fear a potential reduction of the lifespan of the lake due to sedimentation even though studies of other reservoirs indicate that initial projections of that rate are incorrect. Bianchi suggested, in light of Senator Bayh's recent disapproval of the Indianapolis Reservoir project, that the Commission could exercise a little more force in pursuit of a survey. More pressure could be brought to bear upon the Corps at least to get a study on track for 1977. Bron argued that 1977 may well be too late because the development around the Lake appears to be iminent. Heise asked what results could be expected from a preliminary survey. In response Barbara Restle, new chairwoman of the Water Quality Committee, indicated that such a survey would probably be quite trivial. A comprehensive survey is quite complex and must give an indication of where the sedimentation is coming from, not just how much deposition there is. Such information would be necessary in order to design sedimentation basins to protect the reservoir from further sedimentation. Responding to a question of the cost of such a study, Fix estimated around $20,000. He thought the Commission should ascertain the estimate cost and then go directly to Washington for the appropriation. Bron agreed that the City has much to lose should it not pursue this course. Patton proposed that the Commission take initial steps to carry out Fix's proposal by seeking a cost estimate.

The Environmental Commission has been asked by the Plan Staff, to appoint a member to attend meetings at Purdue on the ramifications and possible uses of the information gathered by the Skylab experiments over Lake Monroe.

Bianchi reported that Inland Steel had still not accepted the restrictions placed upon them by the Stream Pollution Control Board and were not on the agenda for the June meeting. In another development, the proposed county zoning ordinance has been amended to provide that no development visible from the shores of Lake Monroe would be permitted, and to require drainage and erosion controls around the lake. This amendment will be discussed June 14, and could use the support of all Commissioners. Bron added that the Forest Service had also decided to deny permits to cross Forest Service land with utility pipelines until a regional plan is devised. Heise pointed out that this would have particular significance for Granves-Monroe and Inland Steel.

July 11 -- Assistant City Planner, Stu Reller, and Dr. David Frey reported on the Lake Monroe-Skylab project and its possible ramifications for environmental concerns.

Bianchi reported that the estimated cost of a sedimentation survey of Lake Monroe is $24,000 for a resurvey of the existing ranges, and $20,000 to complete the range installations. The Corps said its preliminary study scheduled for July should give a reasonable indication of the sediment in the project now. In light of Barbara Restle's opinion that it is more important to know where the sediment is coming from, such a preliminary study would probably not help much, added Bianchi. She pointed out that Sen. Bayh sits on the Appropriations Committee and could be contacted for help in this matter.

The initial response from the Mayor's office, she reported, was a willingness to pursue the request in Washington, asking that the appropriations be made now, rather than in 1977.

September 12 -- Ted Najam discussed the letter, sent to Birch Bayh, concerning a sedimentation study of Lake Monroe. He explained that an earlier letter had been sent to the Louisville District Army Corp of Engineers in reference to the study. Their reply was that they could give only a quick visual estimate at this time, but that funds for an in-depth study would not be available until 1977. Sen. Bayh explained that the 1974 appropriations bill for the Corps has already been passed by Congress and therefore it is impossible to amend it for such a large amount. He expressed his desire to work with the City in getting appropriations for this study during the next funding session. This would make the study possible 2 to 3 years earlier than predicted and in this sense he was encouraging.

In reference to the Department of Utilities' proposal to close Lake Lemon as a water supply, Marcia Gelpe replied that the Water Quality Committee has begun to look into the proposal and tactics that could be used to clean up Lake Lemon. They expressed their feeling to the City's Utilities Board. The reasons for closing have to do with estimates of renovating the facility compared to the cost of Lake Monroe, volume of water and the plant. Patton commented that several investigations are taking place, one of which is a sedimentation report and he assumed the decision won't be made until the information is in.

October 10 -- The Water Quality Committee has been studying the problem of spills of raw sewage into Salt Creek from the Nashville Sewage Plant and sent a letter to the County Commissioners of Brown County asking that a joint meeting be set up to discuss the source of the problem as well as possible solutions. The Commission agreed to send a letter to the Brown County Commissioners endorsing the idea of a joint meeting and asking to be kept informed on the progress on solving the problem.

November 14 -- Dennis King presented a report concerning the meeting of the Lake Monroe Regional Waste District Board and City Utilities Service Board and a request of the Water Quality Committee submitted for an additional hearing on an environmental assessment hearing to determine the environmental effects of the regional sewer treatment plant that is going to be constructed by the City Utilities Service Board and of the diversion system that will be put in by the LMRWDB. The Water Quality Committee said that the LMRWDB had not filed any information prior to the meeting in conjucction with regulations that the EPA has stated and therefore did not give the public a 30-day notice to study the information. The outcome of a request that they hold another meeting was a letter which indicated that another meeting would not be held, but they would put some information on file and answer questions, if there are any. A motion was made by the Environmental Commission and approved that a hearing be held at the regular December Environmental Commission meeting with the Utilities Service Board and their engineers answering questions from the Commission and the public. In addition, the LMRWBD and the Monroe County Plan Commission were requested to attend. Barbara Restle stressed the interrelatedness of these two projects in the Water Quality Committee report.

December 12 -- see attached minutes.

HISTORY OF ENVIRONMENTAL COMMISSION'S INVOLVEMENT WITH LAKE MONROE
Based on 1974 minutes

February 13 -- Barbara Restle read the minutes of the last Water Quality monthly meeting. In short, it said there was concern on the part of many members that an environmental impact statement should be requested by the committee that would deal with the effects of the new sewage plant in greater detail. A working subcommittee was formed to study the assessment hearings held by the USB. It was hoped that this subcommittee would reach a conclusion on the course of action the Water Quality Committee should pursue. No questions or comments were added.
Restle presented to the Commission a summary of the considerations from the subcommittee. She said the summary was by no means complete. The two considerations presented were in the areas of population data projections for Monroe County and problems with the treatment plant site and outfall sewer. Patton recommended that these comments, if approved by the Commission, should become part of the December 12th meeting, Restle agreed but added that more considerations than these two are being questioned. Restle stated that, although the population data appears complete in the assessment it is not. Dennis King explained that one of the first considerations to be included in an assessment is a description of the effect of population distribution concentration on any growth that might occur if the project is undertaken. He said that, with that in mind, the subcommittee went through the Infiltration and Inflow Study and the hearing record for the October 25th environmental assessment hearing and the December 12th information meeting to determine what RSH Associates had done in regard to population projections. King said his impression was that the statistics used in the assessment had projections to 1980-1990 based on the census of 1950-1960. If it is based on these years there would be no influence from the lake on the extraurban area because the lake was not constructed until 1963. King said that the alternatives to the temporary plant site were not mentioned with regards to growth in different volumes and directions. He said the Water Quality Committee is recommending further study. Heise asked if the Water Quality Committee was asking for an environmental impact statement. King replied that at this time they are not asking for an environmental impact statement but only trying to point out subjects that are not adequately investigated. Patton summed up King's comments by saying that the population projection studies are not adequate and the effect of the waste water disposal plant on changes in population have not been assessed at all. King's final comment pointed out that if the population projections have not been adequately looked into one can not design capacity of a plant properly. A copy of these questions will be sent to the USB and EPA administrators. The Commission voted unanimously to forward them.
Jim Ferro reported that at the last monthly meeting of the Water Quality committee another working group was formed composed of Jim Pres, David Docauer, and himself. This working group will investigate the effects of construction activities around Lake Monroe with regards to water run-off. The second major project the working group is considering is one concerning Lake Lemon. This would involve sampling the shoreling during a rainy period to measure runoff.

April 10 -- Jim Ferro said the water sampling project which is being planned to test the quality of the run-off in the Lake Monroe watershed is being organized and should be underway soon.

September 11 -- An ad hoc committee consisting of Rick Peoples, Dave Parkhurst, Rick Darby, and Barbara Heise agreed to study the USB report on the Long Range Plan Water Supply and Distribution Facilities for Bloomington, IN.
Rick Darby gave his report on Lake Monroe. This report concerned the legal standing; how can a reservoir outside of the city boundaries be controlled and what is the relationship of the Commission to that lake, and whether there is

anything the Commission can look into other than water quality itself.

September 25 -- Barbara Restle said that interests in the Water Quality Committee are too broad. There are legal problems, bacteriological problems, limnological problems, sedimentary problems, and more. The committee needs to form subcommittees and she asked for suggestions on restructuring.

November 13 -- Rick Darby gave a report on Lake Monroe. He said that Lake Monroe is a large interest requiring tremendous work. There is no way one person can provide the Commission with enough information for the Commission to feel it is in control with the situation. He has therefore arranged with Professor White in the Law School for students to receive credit for participating in a project designed to prepare a paper or pamphlet which would adequately describe the jurisdiction of various governmental bodies over Lake Monroe, interaction and jurisdiction between this commission and the City, of Bloomington in those various bodies and the rights generally given to individuals in Indiana in the Environmental field. Rick feels with this help, by the first of the year, a comprehensive and fairly clear statement of exactly where the Commission stands can be provided. He then went on to state the legal preceedure the Commission would have to go through if it was to take action and suggestions the Commission should consider. Walter Bron asked if Rick had a specific group in mind other than Water Quality. Rick said no. Rick Peoples gave a report on the status of the Water Quality Committee. The first meeting was held. Only four people showed up but only one was interested in participation.

LEAGUE OF WOMEN VOTERS

BLOOMINGTON, INDIANA

June 9, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JUN 20 1975
PLANNING BRANCH - Region V
FILE NO.

To: City of Bloomington Utilities Service Board
Indiana Stream Pollution Control Board
Region V Environmental Protection Agency
Lake Monroe Regional Sewage Board

From: League of Women Voters of Bloomington-Monroe County

Subject: Addition to our statement of May 29, 1975 for the record of the assessment hearing for the proposed sewage treatment facility at the confluence of Salt and Clear Creeks in southern Monroe County

Our initial statement consisted of an outline of the positions of the League on the issues of water resources and land use, followed by questions regarding the six major issues of EPA concern as stated in the announcement of requirement for an environmental impact statement.

The purpose of this addition to the first statement is twofold. We would like to express our disappointment in the reception given our questions. For most of them there seemed to be little serious attempt to answer them at the assessment hearing. Second, we would like to outline, this time in statement form, our reservations and doubts about the Facilities Plan and First Amendment prepared by Black and Veatch:

I. Regionalization

The concept of regionalization, as it has been used in this long conflict over expansion of treatment facilities for Bloomington's south service area, is fuzzy. The most widely understood meaning of a regional facility is that of a facility planned by two or more local governmental bodies with existing needs which can be more efficiently and economically met by a common facility. That Bloomington's situation fits this description is extremely doubtful.

An additional complication is a semantic problem which has arisen with the use of the words "region" and "regional". These words have been used to describe both the domain of the Lake Monroe Waste District and the larger service area including the Bloomington South Area. The confusion is most obvious when someone uses the phrase "regional plant" which might be for the lake only (3 mgd) or for the larger proposed region (15 or 20 mgd).

The needs of the Lake Monroe area are quite small at the present time and are projected to reach 3 million gallons per day only in 1998. The Lake Monroe area has individual treatment facilities for each of its few developments, since no construction is permitted without approval of treatment facilities. Those which discharge an effluent must have NPDES permits and meet schedules for upgrading their treatment as required by Public Law 92-500.

The replacement of these small treatment facilities with a collector sewer almost completely circling the lake basin west of the causeway and a single treatment plant is a plan which may not, by itself, be economically feasible. There may never be enough users to pay for it. The facilities plan for the Lake Monroe Regional Waste District lists costs of more than $8 million for the collector and interceptor sewers. Presumably these costs are at prices as of October 23, 1974, the date of publication of the report. The constructiion cost listed for a 3 mgd plant is approximately $3.8 million. These costs are to be borne by a present user population of about 1900 home equivalents (370 gpd per home). To finance the total of $11.8 million in construction costs amounts to about $6000 per home equivalent. It seems clear and has been so stated publicly that large developers will be needed to bring the costs per dwelling within reasonable limits.

At the 1998 projected population of about 8000 home equivalents (3 million gpd, 100 gpd per person, 3.7 persons per home equivalent), the cost still amounts to about $1500 per home equivalent for construction alone; and this does not include lateral sewers from collector to dwelling.

In addition single family dwellings not able to be served by planned collector sewers have been included in present and projected user populations for the Lake Monroe Regional Waste District. They will have the additional cost of building a sewer from their lot line to the region interceptor sewer. The cost to serve scattered single family dwellings would be extremely high.

There is no existing legal mechanism for forcing homes now using septic tanks to hook onto the planned sewers. There is a state law requiring homes within 300 feet of a sewer to hook on; but this has not been uniformly enforced even within the Bloomington city limits. Moreover there does not seem to be a mechanism for taking existing small treatment plants out of service and forcing their users to hook onto the region's interceptor. It seems probable that many users would reject this expensive alternative unless there are legal means to compel them to accept it.

If the concept of providing sewer service for these areas of low population density proves unworkable, we are left with a rather small probable service area for a Lake Monroe regional plant at the site proposed. This area might reasonably include The Pointe, the Fairfax area, Seven Flags Corporation, possibly Harrodsburg. The total projected flow from these communities by 1998 is 843,863 gpd compared to 3,000,000 gpd for the whole lake area. (page 15, Lake Monroe region facilities plan)

There is already in existence a treatment plant built for The Pointe with a capacity of 116,000 gpd. The effluent of this plant discharges into Little Clear Creek, out of the Lake Monroe watershed. This "interim plant" represents a large investment and might not be willingly abandoned even if Bloomington chooses the proposed Salt Creek site for its South Area plant.

In summary of our thinking on the regional concept, we would like to see more cost factors discussed. At what population density does it become cost effective to go to one big regional plant? Do any cost projections consider a planning span long enough to include replacement of sewers? What is the state of the art for small (less than 1 mgd) treatment plants? For individual home treatment? Is there an increased cost for "old" users when their sewer service area is broadened? Should a densely populated, efficient service area share treatment plant construction costs with a sparsely populated, inefficient service area? Do the growth projections accurately predict what will happen when a service area is greatly expanded? Might not a slowly growing Bloomington South area find itself paying the costs for a rapidly growing area southwest of Lake Monroe?

II. The Capacity(ies) and Location(s) of a Regional STP or Separate STPs

A. Capacity

There are a number of important unanswered questions relating to the amount of new plant capacity which is needed. In the original facilities plan (December 4, 1974) a figure of 14.9 mgd was given for the Bloomington South area for 1998. In the First Amendment to the facilities plan (March 20, 1975), after a recalibration of flowmeters at the Winston Thomas plant, this figure was changed to 17.6 mgd. (In both cases the flow contribution estimated for the Lake Monroe area is 3 mgd.)

Included in these figures is 1.9 mgd now treated at Bloomington's north treatment plant, the Blucher Poole plant. This compares to a total of 2.7 mgd treated at that plant.

When this 1.9 mgd is taken away from the flow at the north plant, only 0.6 mgd remains, a figure well below the design capacity of the plant (6 mgd). Are we justified in building new plant capacity for this 1.9 mgd? Without it the South area flow would be 15.7 mgd for 1996.

Another uncertain factor is the final outcome of infiltration/inflow studies now underway. The Facilities Plan lists figures of 1.6 mgd for present dry weather infiltration and 0.5 mgd additional wet weather infiltration. Another 0.9 mgd from infiltration/inflow is projected for 1996. This amounts to 3 mgd out of a total of 17.6 mgd for 1996. (These infiltration/inflow figures were not repeated in the First Amendment, so the figures given are from the original Facilities Plan.) The Facilities Plan analysis of this situation is: "inflow and infiltration into the existing sewers will tend to increase with age of the system. Maintenance of the system will be continued but the recent inflow/infiltration studies have indicated that extensive repairs will not be cost-effective." The studies are still in progress, however, and the final conclusions may be different. Neither of the firms involved in the first phase of the study will be involved in the second phase. The Utilities Board has recently accepted the bid of American Consulting Services, Inc. of Minneapolis, Minn. for the second phase. It is to be hoped that their calculations of the cost-effectiveness of renovation will include the costs of new plant treatment capacity construction.

The two factors discussed above are applicable to either the Bloomington South area alone or combined with the Lake Monroe area. A third factor applies only to the larger service area. This factor, discussed above under regionalization, is that of the probability of success for completion of the collector and interceptor sewers around Lake Monroe. The 1996 flow figure for the lake area (3 mgd) is based on the complete network as shown in the Beam, Longest and Neff Facilities Plan. If the complete network cannot be financed, then a plant at the Salt Creek site might serve only those developments within two or three miles of the plant. The flow from this restricted area might not exceed 1 mgd and could be much less if the new "interim plant" is not abandoned.

A final factor not even mentioned in the Facilities Plan is the conservation of water use which might be achieved within the plan period. This might be brought about by consumer education, a reform in the rate structure to reward conservation rather than high volume use, the depressed economy, or the higher rates resulting from the planned construction. The Facilities Plan projects an increasing per capita consumption in a time when there is rapid development of the technology for water reuse and even individual home treatment. These trends in the technology have obvious cost benefits to the buyer of water and sewer services.

To summarize our thoughts on plant capacity, there would appear to be a number of reasons to question an initial design capacity of 20 mgd (as recommended in the First Amendment). For the Bloomington South area 15 mgd is a preferable design capacity, with provision for staged enlargement of capacity. If the decision is made to serve the South area and the Lake Monroe area with a single plant, the 15 mgd would still be adequate with staged enlargement depending on the speed of development in the area.

B. Location

Obviously the location problem is tied up with the choice between one large and two or more smaller plants to serve the region. If the choice is one large plant and it is expected that the entire Lake Monroe interceptor sewer system can be built, the Salt Creek site might be the best location (only location is considered here), but it would certainly seem foolish to build a gravity outfall sewer all the way down Clear Creek and a parallel interceptor sewer down Little Clear Creek valley when the two might be combined in Little Clear Creek valley. If, however, it is decided that the southwest corner of the lake might be served by its own plant (the "interim plant", already constructed there discharges out of the lake watershed), then the remainder of the lake service area might be just as well served by a plant at Dillman Road or Ketcham Road. This would remove the necessity for the interceptor sewer from Smithville down the Little Clear Creek valley to Salt Creek and the necessity for 11 miles of outfall sewer down Clear Creek.

No cost comparisons have been made for the alternative just described, with a small plant serving the south part of the lake and a Bloomington plant at Dillman Road or Ketcham Road serving the north part of the lake area. (The Facilities Plans calculated costs for a separate lake plant serving the entire lake area.) It might turn out to be the cost-effective solution for the planning region. It would eliminate most of the Clear Creek gravity outfall sewer which has caused so much environmental concern.

III. The Treatment Process Best Suited to Specific Sites

We will not attempt to evaluate the relative merits of available sewage treatment processes. This does, however, seem to be an engineering specialty in which there is much current research and a great many developing new methods. In addition, the requirements of Public Law 92-500 are for increasingly high effluent quality to the point where the size of the receiving body of water will not be considered as important as it is at present.

The implication of the above situation for Bloomington's choice are as follows:

a) The treatment chosen should be capable of being changed or treatment steps added, to the extent possible with present knowledge.
b) It seems likely that treatment level required in the future will be higher than that required at present.
c) The level of treatment required for the Clear Creek sites probably is closer to future requirements than that required for the Salt Creek site.
d) The larger acreage at the Salt Creek site probably gives more improvement flexibility, depending on the space requirements for improvements.
e) The cost balance between Salt Creek and Clear Creek sites might well change before the end of the planning period if a higher level of treatment becomes mandatory at the Salt Creek site, since the cost effectiveness of the latter depends on its lower level of treatment.
f) Alternatives involving small treatment plants depend on the ability of such plants to produce effluent of high quality.

IV. The Environmental Impacts of Construction and Operation of STPs, Interceptors and Outfall Sewers

The most important environmental impact of the construction and operation of the STPs would seem to be the quality of the effluent produced, and possibly the odor in the immediate vicinity of the plant. Another impact, of course, would be the amount of site preparation necessary. The Audubon Society has questioned the stream rechannelization which is proposed in the Facilities Plan. We leave this point to them and the engineers.

With regard to the quality of the effluent produced, any of the Clear Creek sites is superior to the Salt Creek site in this respect.

As far as secondary water quality impacts are concerned, we feel unable to predict these. The number of septic tanks abandoned, small treatment plants shut down, facilitation of development in the Lake Monroe area, water quality impact of that development, are all unknown quantities. There are water quality arguments on both sides of the controversy. Statements have been made that a large regional plant is essential to Lake Monroe water quality, and that a large regional plant is fatal to Lake Monroe water quality. We are unable to reach either of these conclusions. Both sides of the argument seem to have been overstated. A small Lake Monroe region treatment plant can easily be built and would seem to have the same advantages and disadvantages for Lake Monroe water quality as a larger plant built by Bloomington. We would like to see the primary emphasis placed upon other factors.

The direct environmental impact of the interceptor and outfall sewers construction and operation is considerable. Discussion of this issue is omitted here because others have addressed this problem. Alternatives should be evaluated with a goal of minimizing sewage construction impact. It is not clear that the present plan does this.

The secondary effects of sewer construction are another matter entirely. In the absence of other more powerful forms of planning for development, the construction of sewers is equivalent to planning for development. One may therefore expect that a loose, sprawled network of sewers will lead to the same sort of development. These in turn require loose, sprawled networks of roads, schools, school buses, refuse collection. All of these services cost more than their clustered counterparts, and this probably means that they have more environmental impact as well.

Considering the effects of sewer placement, a plant for Bloomington should be placed close to the planned development area for Bloomington, and a plant for Lake Monroe should be placed close to the area of planned or expected development for Lake Monroe. If long connecting sewers passing through undeveloped areas are planned, then some means of controlling development along them should be found in advance of construction.

It is not clear how development along the interceptor sewer ringing Lake Monroe could be controlled, except in the inaccessible force-main portions. In this respect, several carefully planned and well regulated small treatment plants might be preferable, if they are capable of achieving effluent of the required quality.

V. The Induced Growth Implications for the Lake Monroe Area of Building a Regional Sewage Treatment Plant

On this issue like the Lake Monroe water quality issue, extreme statements have been made. On one side it has been said that construction of a regional plant at the Salt Creek site will result in rapid, unplanned development of the lake area. On the other side it has been said that development will take place even without a regional plant. Both sides cite lake water quality as an important concern. Both sides (despite the threat of development without a plant) seem to feel that development of the Lake Monroe area is closely linked to obtaining a regional treatment plant at the Salt Creek site. It is this link which is holding up a long overdue expansion of treatment facilities for Bloomington's south area.

A great improvement in everyone's logical though processes might be achieved at this point if Bloomington's future and Lake Monroe's future were considered separately, as regards sewage treatment needs. This probably means separate sewage treatment plants. It is not necessarily true that Lake Monroe development would ride along on the coattails of Bloomington's treatment plant expansion. But the best way to be sure of fair consideration of both interests is to find a cost equivalent plan for two or more plants to serve separate density areas.

VI. The Best Method of Sludge Treatment and Disposal

This issue, like the one involving treatment processes, is for experts in the technology. The situation does seem to be under intensive study as indicated by published articles. Changes are likely in recommended methods. It would therefore not seem wise to base arguments for choice of plant site on a disposal method which might change even before the plant is built. From the same line of thinking, several disposal alternatives should be possible for each site.

VII. Conclusions

There is an alternative to a large regional plant which should be considered. This alternative would involve first selecting a plant site which would best serve the Bloomington South area present and future needs. After site selection it would then be determined which portions of the Lake Monroe area could be served at the chosen site. Other treatment facilities for the lake area might then be planned at one or two sites near expected dense development.

The Land Suitability Study prepared by the Indiana University School of Public and Environmental Affairs has indicated the southwest corner of the lake as the area most suitable for development. Planning for sewage treatment for the lake area might focus on this corner until the economics of the lake interceptor sewer plans are worked out.

Either the Dillman or Ketcham Road site could serve the north lake area, while a small plant near the dam could serve the south lake area.

This alternative would avoid the considerable difficulty of planning a sewer network to connect two planning areas which are separated by a large stretch of undeveloped land. It would avoid both the environmental and unplanned development impacts of building long sewers through open countryside.

The Salt Creek site has the advantage of larger size and smoother terrain. The use of Salt Creek for dilution and of site acreage for sludge injection may be undesirable in the near future and should not count as reasons in favor of the site. Use of the site involves the problem of very long sewer to connect it to the present plant. The long controversy which has been centered on this site is a reason in itself for not choosing it if acceptable alternatives are available.

The question of initial capacity contains several issues which should be examined further; the infiltration/inflow problem, the future use of the north treatment plant, conservation by users, and the portion of the lake area to be served. An adequate solution would seem to be a 15 mgd plant to which 5 mgd capacity could be added when needed, depending on the issues listed above.

Sincerely,

Shirley Cordes

Shirley Cordes, Chairman
Environmental Quality Committee
League of Women Voters of
Bloomington-Monroe County
(2728 Pine Lane, R.R. 3)
339-9364

ENVIRONMENTAL PROTECTION AGENCY

PLANNING BRANCH - Region V

FILE NO.

May 29, 1975

US Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

THE SASSAFRAS AUDUBON SOCIETY
of LAWRENCE · GREENE · MONROE
BROWN · MORGAN AND OWEN COUNTIES

Dear Mr. Hirt:

In regard to your letter of May 14, 1975, the Sassafras Audubon Society is interested in contributing to the preparation of the Draft Environmental Impact Statement on the location of the new wastewater treatment system in the South drainage basin of Bloomington, Monroe County, Indiana. The principal question, as stated in your letter, is whether to build one sewage treatment plant (STP) for south Bloomington and the Lake Monroe area or separate STPs.

We believe that a site near Bloomington would be advantageous in terms of curbing urban sprawl and strip development, in minimizing environmental disruption, and in overall economy of operation and maintenance. We recommend serious consideration of the Dillman Road Site without rerouting of Clear Creek.

We further recommend that sewage treatment facility expansion at Lake Monroe be curbed until comprehensive land-use planning is in effect for at least the area encompassed in the Lake Monroe Land Suitability Study. We see serious consequences if a Regional Sewerage System is instituted at Lake Monroe prior to land-use planning for the Lake Monroe Watershed.

The Sassafras Audubon Society in March, 1974, sent Region V, EPA (under cover letter to Francis Mayo), a file of bibliographical material, correspondence, news articles, etc on issues and problems surrounding Lake Monroe. Region V also has a copy of the lengthy statement we presented at the Hearing on the Black & Veatch Facilities Plan held in March of this year.

We enclose with this letter the brief statement we prepared for the May 29, 1975 Environmental Assessment Hearing on the siting of the STP, as well as a statement sent to the Monroe County Plan Commission (MCPC) by a number of organizations seeking implementation of the Lake Monroe Land Suitability Study.

As you know, the MCPC has jurisdiction for land-use planning of a large and vital area of the Lake Monroe Watershed. The MCPC made no comments on the Draft Lake Monroe Land Suitability Study though asked to do so by the Director of the study (the MCPC received one of the four draft copies). They have said that when the study is in final form, they will read it and discuss it.

Please let us know how we can contribute to preparation of the Draft Environmental Impact Statement.

Yours sincerely,

Mrs. David G. Frey

6-102

Lake Monroe Committee for the
Board of Directors, Sassafras Audubon Society

THE
SASSAFRAS
AUDUBON
SOCIETY

OF LAWRENCE · GREENE · MONROE
BROWN · MORGAN AND OWEN COUNTIES

May 1975

Statement presented at Environmental Assessment Hearing on Facilities Plan for Wastewater Treatment System, South Drainage Basin, Bloomington, Indiana.

The Sassafras Audubon Society has studied the various sites Black & Veatch have considered for placement of the south basin wastewater treatment system, and recommends the Dillman Road Site. This site, while rural, is close to the Bloomington Metropolitan Area and a gravity feed system is possible without serious environmental disruption.

We would ask, however, that Black & Veatch prepare an alternative plan for the Dillman Site without rerouting Clear Creek. The proposed plan (Figure VIII-5) would sacrifice a substantial part of the longest continuous piece of the site for a new creek channel. Examination of the site suggests that the present major piece of land between the railroad and the creek channel would be adequate for most of the design capacity. Adjacent acreage could be utilized if necessary and still maintain a compact unit for operation and maintenance, even though line(s) across Clear Creek might be involved. Besides, channelization has proven repeatedly to be a destructive management practice entailing considerable costs in construction and maintenance, and exacting downstream damages to stream ecology.

Two statements which Black & Veatch make with regard to the Dillman Site have little merit: 1) "By 1998 it is not unlikely that the plant site would become surrounded by development comparable to that which presently rings the Winston Thomas Site." (VIII-4), and "Acceptance of the Dillman Road Site is questionable due to the close proximity of State Route 37 Bypass." (IX-1). The Dillman Site, if accepted, could be effectively zoned to prevent build-up in the plant area. The greater part of the site is adequately buffered in terms of SR 37, and more could be done, if necessary, to lessen the affront to sensitive motorists!

Mention is also made with regard to the Dillman Site that "There would be no surplus area available for construction of additional facilities if further advanced treatment processes, such as denitrification, were mandated in the future." (VIII-4). This needs clarification, since the possibility exists that denitrification may be required by the Federal Government within a few years. Couldn't the space used for nitrification facilities be converted to denitrification? When denitrification is required, wouldn't this nullify the advantage of the Salt Creek Site over the Clear Creek Sites, as emphasized by Black & Veatch on pages III-1 and III-2?

The Black & Veatch Reports continue to seem slanted toward maximizing the advantages of the Salt Creek Site while minimizing the advantages of the sites significantly closer to the Bloomington Metropolitan Area. No assessment of the environmental damages which could result from construction of the lengthy transport system to the Salt Creek Site have been made by Black & Veatch. Environmental damages should be considered a cost of the project and not dismissed under the euphemism of "temporary disruption." (IX-9).

The fact that there is sufficient acreage at the Salt Creek Site for use of the sludge injection process is stressed as an advantage of the site, yet no evaluation is given of the soils of the area in terms of the process, nor of difficulties which might be encountered. Composting of sludge should be considered for all sites. (See Sassafras Audubon Society Statement to Utility Service Board, February 1975, pages 2-3.).

Black & Veatch assert (IX-10) that "Sewerage service for the Lake Monroe region is necessary to preserve the ecologic value of the area." While there is grave need for a new wastewater treatment system in the south drainage basin of Monroe County, we continue to assert that sewerage is but one of the factors that must be considered in the protection of Lake Monroe. LAND-USE PLANNING FOR THE LAKE MONROE WATERSHED SHOULD HAVE AS HIGH PRIORITY AS THE DEVELOPMENT OF A REGIONAL SEWERAGE SYSTEM. Implementation of the Lake Monroe Suitability Study by the Monroe County Plan Commission should be of prime importance to the Bloomington-Monroe County Community.

The Board of Directors
Sassafras Audubon Society

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JUN 1[illegible] 1975
PLANNING BRANCH - Region
FILE NO.

Harlan D. Hirt, Chief
Region V Planning Branch, EPA
230 South Dearborn Street
Chicago, Illinois 60604

THE SASSAFRAS AUDUBON SOCIETY
of LAWRENCE · GREENE · MONROE
BROWN · MORGAN AND OWEN COUNTIES

June 16, 1975

Dear Mr. Hirt:

We would like to call the attention of the Planning Branch of Region V, EPA, to the Strain Ridge School controversy in Monroe County, as it has implications with regard to the siting of the new treatment plant.

There was organized opposition to the placement of a school at Strain Ridge when it was first proposed, because Smithville citizens wanted to retain their community school, and the citizens of Harrodsburg and Kirksville sought a community school near the center of their populations (combined) which would require significantly less bussing than to Strain Ridge.

We are enclosing several recent news items from the Bloomington Daily Herald-Telephone which will give you some idea of the interest and arguments this issue has engendered. The issue is more complicated than can be presented here, but we do not feel the issue is whether the children in these particular areas will be deprived of proper educational facilities, but where those facilities should be placed. It should be noted that if a Sewage Treatment Plant (STP) were placed at the Dillman Road Site, it could service a community school at Smithville.

> THE SASSAFRAS AUDUBON SOCIETY WOULD LIKE TO REITERATE ITS SUPPORT FOR A STP NEAR THE BLOOMINGTON METROPOLITAN AREA. WE BELIEVE THAT A PLANT AT THE DILLMAN SITE COULD BE A REGIONAL STP IN THE BEST SENSE OF THE WORD, SERVING THE NEEDS OF AN EXPANDING, SEWERED, METROPOLITAN POPULATION, BUT ALSO STIMULATING THE DEVELOPMENT OF A SEWERAGE SYSTEM FOR THOSE BUILT-UP AREAS IN THE SOUTH BASIN SERVICED BY RURAL WATER SUPPLY SYSTEMS BUT STILL DEPENDENT ON SEPTIC TANKS. CONCEIVABLY, ALSO, PARTS OF THE NORTH WATERSHED OF LAKE MONROE WHICH WOULD INCLUDE THE PAYNETOWN RECREATION AREA, etc WOULD BE WITHIN A REASONABLE RANGE.

We were disturbed at the Final Assessment Hearing in May to hear the stress placed on the advantage which the Salt Creek Site had over Clear Creek Sites in terms of dilution water, (by Black & Veatch and a pepresentative of the Water Pollution Control Division of the Indiana State Board of Health.) We must deal with realities in terms of lack of implementation of provisions for the high degree of treatment (or zero discharge) sought by the recent Federal Water Pollution Control Act Amendments, and insufficient appropriations for constructing STP's capable of such treatment. Nevertheless, we do have goals, we are working on the technology and planning for achieving those goals. It is not good policy to use a lesser standard as a selling point for a site on the grounds that it is cheaper.

Furthermore, it is possible that in the future Lake Monroe's function as the principal water supply resource of the entire Region will assume top priority in the management of the lake. The Sassafras Audubon Society is working for that top priority recognition. It is conceivable then that low-flow downstream would become a lesser function of the lake during periods of prolonged drought. If so, the site advantage could become a disadvantage.

We advocate sludge recycling but object to the approach of recommending a process of sludge disposal (soil injection) as an advantage of the Salt Creek Site prior to an evaluation of the soils and the process through on-site research. We quote from the Abstract of the paper of Paul Blakeslee "Monitoring Considerations for Municipal Wastewater Effluent and Sludge Application to the Land" presented at the Joint Conference on Recycling Municipal Sludges and Effluents on Land in 1973:

> "Monitoring the performance of the many interrelated systems which are involved in any project employing wastewater or wastewater sludge application to the land can not be looked upon as a substitute for a full understanding of system response prior to project committment."

We would appreciate having the Dillman Road Site re-evaluated from the standpoint of "environmental" engineering, to see if the site could be utilized to better advantage than projected in the First Amendment to Facilities Plan of Black & Veatch.

Will there be an opportunity to meet with representatives of Region V EPA on this matter when they are in the area?

Sincerely yours,
Mrs. David G. Frey
R3, Smith Road, Bloomington, IN 47401

for the Board of Directors
Sassafras Audubon Society

Dale Leucht
Planning Division
Region V EPA
230 South Dearborn Street
Chicago, Illinois 60604

THE
SASSAFRAS
AUDUBON
SOCIETY
of LAWRENCE · GREENE · MONROE
BROWN · MORGAN AND OWEN COUNTIES

July 2, 1975

Dear Mr. Leucht:

Enclosed are copies of three recent news items from the Bloomington Herald-Telephone which relate to the siting of the south side sewage treatment plant.

On June 17 the Utility Service Board heard a presentation from Scarab Composting Company of Bloomington for accepting all the city's sludge. The proposal is being considered by the Board. The implications of this proposal are obvious, if implemented, since a leading argument for the Salt Creek Site is the space available for the sludge injection process. We have advocated consideration of composting as an alternative to the injection process, and would like to see serious consideration given to this proposal.

The Statement of the Monroe Engineering Society (signed by Ray Graham, County Surveyor and member of the Monroe County Plan Commission, and Ray Long, City Engineer) backing the Salt Creek Site is essentially an endorsement of the Black & Veatch recommendations, using similar arguments for their decision.

Emphasis is placed both in the engineers statement and the H-T editorial on the argument that the operation and maintenance expenses would be higher at the Clear Creek sites. This is based on the higher degree of treatment which would be required at the Clear Creek sites and high costs of sludge disposal at same sites. We have discussed these matters previously and can only reiterate that they have not considered all the factors involved, e.g. what the situation might be if effluent standards are adopted and enforced, implementing recent amendments to the Federal Water Pollution Control Act, if denitrification facilities are required at both sites, if water supply is recognized as a top priority function of Lake Monroe (as we believe it should be) etc.

The Engineering Society also fails to consider any alternative to landfill for the Clear Creek sites and blindly accepts the sludge injection process for the Salt Creek Site as if it had neither problems nor expenses associated with it. There are unknowns associated with the sludge injection process which can only be resolved by research and continuing studies in the field. Particularly important is thorough analysis of the capabilities of the site which in this instance is lacking although the survey of soil types of the area has been made. Perhaps better drainage might be needed, and this would be a cost of the project. In addition, also, to the costs of storage, transport, and injection of sludge, would be the need for continuing research on what happens to the sludge components in the soil and in the crops etc.

Our Society would like to see the sludge recycled whatever process is used. We realize that it could be expensive, perhaps, especially in initial stages when an adequate and acceptable method is being developed. However, a community should feel an obligation toward recycling such a resource.

The assertion by the engineers that permanent damage in Clear Creek Valley can't be substantiated reflects the viewpoint that [illegible] the end justifies the mean, and 2) ignorance of the word "damage" from an ecological standpoint. Actually, one type of damage which could result from interference with the stream channel, and its watershed, has been widely demonstrated in our country in terms of changes in natural systems, drainage patterns etc. It is difficult to see how long-lasting damage could be avoided if there are numerous crossings of Clear Creek involved in the laying of the very large interceptor sewer. Recent experiences with rock-slides at road cuts on South 37 indicates the complexity of problems associated with construction in this area.

Both at the last environmental assessment hearing and in the engineers statement it was noted that nature rapidly heals scars of construction and the North Sewage Plant outfall sewer was given as an example of how soon a sewer construction project can be hidden by nature. What is not recognized is that out of sight (disguised by vegetation or hidden under the creek) is not necessarily out of mind in terms of continuing effects if serious alteration of channel and watershed has been effected.

We also take exception to the comparison of the North sewer line with the proposed line to Salt Creek because of the greater length involved to Salt Creek and the magnitude of the topographical problems. The North line had one short passage through rugged terrain and then followed the flood plain to the Bottom Road plant. Even so, the laying of the north line was a travesty of environmental planning! Enclosed is a copy of page 3 of The Balancer (newspaper of Soil Conservation District) which depicts and describes the situation. As we understand it, the City had to absorb costly changes in the laying of the line.

The news article on the Engineering Society's statement ends on the note that one plant is more economic than two, and that the Lake Monroe Regional Waste District will probably construct a plant somewhere south of Harrodsburg if the Clear Creek site is selected. While we would agree that one regional plant would be more economic than two, there are alternatives which haven't been fully considered for dealing with effluent now entering the lake and questions of policy concerning the management of Lake Monroe are still to be answered which could affect what is needed in the way of a plant at that site (or if there is any need at all beyond the plant now in process of construction at Little Clear Creek).

We reiterate our concern for any action which would promote growth and development around Lake Monroe----AN AREA OF CRITICAL ENVIRONMENTAL CONCERN BECAUSE IT IS THE CHIEF (AND LAST) WATER SUPPLY RESOURCE OF THE BLOOMINGTON METROPOLITAN AREA) in the absence of any combined effort on the part of governmental agencies concerned with its management to evaluate and determine what levels of development and use can be absorbed without seriously affecting water quality.

The issue is what is best for the public interest in this instance as the Lake was created with public funds and the life of a community is involved.

Reproduced from best available copy.

A land-use policy for the perimeter and the entire watershed of Lake Monroe needs to be adopted but has not been considered as yet. Standards must necessarily be more stringent for protection of a communal water supply.

Our Society would also like to go on record as favoring a 20 mgd plant in order to provide for built-up areas in need of sewer service and for future expansion around the metropolitan southern area.

In conclusion, we would like to stress a point already covered but which needs to be emphasized since the argument used for the Salt Creek Site tends to center around degree of dilution water:

> "The emphasis of national water pollution control policy is now on the amount of wastes that can be kept out of surface waters, rather than on the amount of wastes that can be assimilated by the waters. This emphasis will guide future acceptable water resource policies."
> (From Characteristics and comparative magnitude of non-point sources by Raymond C. Loehr, Journal of Water Pollution Control Federation, 1974, 46-(8): 1849-1872. Mr. Loehr is professor of civil and agricultural engineering, Cornell University, Ithaca, N.Y.

Yours sincerely,

for the Board of Directors,
Sassafras Audubon Society
R3, Smith Road
Bloomington, Indiana 47401

Reproduced from best available copy.

D) LETTERS FROM INDIVIDUALS

741 Eigenmann Center
Indiana University
Bloomington, IN 47401
June 3, 1975

Region V Office
Environmental Protection Agency
1 North Wacker Drive
Chicago, IL 60606

Gentlemen:

With regard to the environmental impact statement you have decided to write concerning the siting of the proposed Bloomington sewage treatment plant, I believe that the following points, in addition to those made in the report of the Bloomington Environmental Quality and Conservation Commission, should be considered:

(1) The amount of rock to be removed by blasting during the construction of the outfall sewer. The assumption made by Black & Veatch in their Facilities Plan that the soil depth along Clear Creek is equal to the average Monroe County soil depth is tenuous. More blasting would quite probably result in higher economic and ecological costs.

(2) Identification of sludge injection sites in the Dillman Road site vicinity. If soil injection could be used as a sludge disposal method at that site, it would substantially reduce the present worth of that alternative from the Black & Veatch estimate.

(3) Identification of the soil types at the various sites and their implications for plant construction and ionic leaching from sewage.

While I realize that resource constraints may prohibit a full investigation of these points, I think that, to the extent that they can be considered, the EIS will benefit from them.

Sincerely,

James Chiesa

Indiana University Alumni Association
AREA CODE 812 / 337-1711
Office of the Executive Secretary

INDIANA MEMORIAL UNION / BLOOMINGTON, INDIANA 47401

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
[illegible] 1975
PLANNING BRANCH - Region V
FILE NO.

June 17, 1975

Mr. Dale Luecht
United States Environmental Protection
Agency, Planning Branch
12th Floor
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Luecht:

I would like to endorse the Salt Creek site as the best location for the Waste Treatment Plant to serve Bloomington and that part of Monroe County which is in the natural drainage area.

I believe the Salt Creek site will not only serve a much larger area for a collection system, but it will also result in less environmental damage than any other site to which serious attention has been given.

I am interested in environmental considerations for our community and believe that the Salt Creek site will provide the greatest protection.

Sincerely yours,

Frank B. Jones

Frank B. Jones, CAE
Alumni Secretary

FBJ:jh

Winner of three national Alumni Administration awards for comprehensive excellence in alumni programming

BUILDING AND CONSTRUCTION TRADES COUNCIL
IN AFFILIATION WITH
BUILDING AND CONSTRUCTION TRADES DEPARTMENT
AMERICAN FEDERATION OF LABOR—CONGRESS OF INDUSTRIAL ORGANIZATIONS

Address of Writer 2335 Vernal Pike, Bloomington, Ind. 47401

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
[illegible] 1975
PLANNING BRANCH - Region V

June 18, 1975

Mr. Dale Luecht
United States Environmental Protection
Agency, Planning Branch
12th Floor
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Luecht:

The Bloomington Building & Construction Trades Council is a Council of representatives from all the fifteen Construction Unions in this area. As it was impossible for us to attend the public meeting this letter is to advise you that the Council has went on record to support the Salt Creek site for Construction of the new Waste Treatment Plant for the Bloomington Indiana area.

This site would serve a much larger area that badly needs a sewage system.

Sincerely yours
John Lampkins
John Lampkins
S/T

United Brotherhood of Carpenters and Joiners of America

LOCAL UNION NO. 1664
3335 VERNAL PIKE
BLOOMINGTON, INDIANA 47401
PHONE: 812/336-4350

June 18, 1975

ENVIRONMENTAL PROTECTION AGENCY
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JUN [illegible] 1975
PLANNING BRANCH - Region V
FILE NO. ________

Mr. Dale Luecht
United States Environmental Protection
Agency, Planning Branch
12th Floor
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Luecht:

The Carpenters in the Bloomington, Indiana are very much interested in the proposed Waste Treatment Plant for this area.

When building a house, apartment, store, office, school, factory or what ever, it is only good business to design and locate the structure so that it will be utilized to its fullest extent. For these reasons and others we want to urge your approval of the Salt Creek site for this plant.

As you may know Monroe County Indiana does not have maney areas that are suitable for Septic Systems. The Engineering report given in the local paper recomended this site to service a large area and thereby eleminating maney other possible environmental problems in the future.

We further think this plant should serve the greatest number of people at the lowest possible cost. The Salt Creek site is the best suited to do this pluss protecting the environment of the largest possible area.

Sincerely yours
John Lampkins
John Lampkins
B. A.

REGESTER & NAJAM
ATTORNEYS AT LAW
1004 WEST SIXTH STREET
BLOOMINGTON, INDIANA
47401

JAMES R. REGESTER
EDWARD W. NAJAM, JR.

TELEPHONE
AREA CODE 812
332-3334

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JUN 11 1975
PLANNING BRANCH - Region V
FILE NO.

June 4, 1975

Mr. Dale Luecht
United States Environmental Protection Agency
Region V, Planning Branch
230 South Dearborn Street
Chicago, Illinois 60604

RE: City of Bloomington, Indiana
Wastewater Treatment
Disposal of Sludge

Dear Mr. Luecht:

It is our understanding that you are presently evaluating various proposals for construction by the City of Bloomington of a new wastewater treatment facility. You have been referred to us by Mr. Gary Kent, Director of Utilities, and Mr. Rick Peoples, Utilities Chemist.

The Scarab Compost Company has developed a process for the accelerated decomposition of organic matter. The Company can process virtually any organic substance, e.g., leaves, grass, sawdust, wood chips, cardboard, paper, etc., and can convert such organic material into a mineral rich dirt in a period of thirty (30) days.

The Company has worked with the Indiana State Board of Health in cleaning up the Bloomington Packing Company by disposing of its organic refuse through composting. The Company has also, by way of experimentation, disposed of sludge left over from the City of Bloomington wastewater treatment process.

The Company now has a tentative agreement for a contract with the City of Bloomington to dispose of the sludge material produced by both the Winston Thomas and Blucher Poole waste treatment plants. The end product from this process will be a harmless, odorless and mineral rich black dirt.

We believe that the process which Scarab has developed holds great promise as an alternative to conventional land applied means of disposing of sewage sludge. We would like to discuss this process with you or other representatives of the Environmental Protection Agency, with emphasis on the high cost effectiveness of the Scarab method and the environmental benefits.

Please let us hear from you at your earliest convenience.

Very truly yours,

SCARAB COMPOST COMPANY, INC.

By Edward W. Najam, Jr.
Edward W. Najam, Jr.

EWN:ap

REGESTER & NAJAM
ATTORNEYS AT LAW
100½ WEST SIXTH STREET
BLOOMINGTON, INDIANA
47401

JAMES R. REGESTER
EDWARD W. NAJAM, JR.

TELEPHONE
AREA CODE 812
332-3334

August 8, 1975

Mr. Dale Luecht
United States Environmental
Protection Agency
Region V, Planning Branch
230 South Dearborn Street
Chicago, Illinois 60604

RE: City of Bloomington, Indiana,
Contract for Sludge Disposal
Through Composting

Dear Mr. Luecht:

Since I met with you and Cathy Grissom in Bloomington on July 17th, the Scarab Compost Company has signed a sludge disposal contract with the City of Bloomington to compost the sludge produced by the City's present wastewater treatment plants. A copy of the Contract is enclosed herewith.

The purpose of this letter is to request that the Environmental Protection Agency and its consulting engineers fully consider and evaluate composting as a sludge treatment alternative in preparing the Environmental Impact Statement for Bloomington's proposed wastewater treatment facility.

In our Contract with the City, our objective is to demonstrate, in practical use, the desirability and feasibility of composting sewage sludge. We believe that composting is the most effective method of sludge treatment and disposal both in terms of environmental protection and solid waste resource recovery and utilization.

Our Contract with the City provides for testing and evaluation of digested sludge both before and after composting. We anticipate that, given the constituent character of Bloomington's digested sludge, the concentration of heavy metals and other contaminants before composting will be acceptable and will improve in the future with pre-treatment. After the sludge is composted with other organic materials, e.g. leaves, sawdust, corn cobs, etc., there is a significant dilution factor in the finished product.

The Scarab compost process also achieves significant pathogen reduction. Accelerated bio-degradation generates temperatures which disinfect the digested sludge in a natural process of stabilization through bacterial action.

In addition, the Scarab aerobic or "open stomach" method requires a limited energy investment, a factor of increasing significance which should be considered in evaluating various sludge disposal alternatives.

The Federal Water Pollution Control Act Amendments of 1972 call for the development of alternative means of sludge disposal and utilization. As you know, traditional land application of digested sludge presents significant problems of soil and water contamination. These problems can be controlled and significantly reduced or eliminated by adequate composting under controlled conditions.

To insure safe operation and control while the sludge is being processed, our Contract provides for inspection by the City and other appropriate public agencies, including the Environmental Protection Agency. We invite you and your consulting engineers to participate in the evaluation which will be conducted by the City's Environmental Quality and Conservation Commission.

There are not many people qualified and capable of producing large amounts of compost on a commercial scale through an accelerated process of bio-degradation. The President of our Company, William Addison, was among the original group of persons involved in the 1930's in compost research at George Washington University at College Park and Beltsville, Maryland. Mr. Addison's early work involved field research in agriculture and animal husbandry and the creation of organic substitutes to commercial fertilizers. In his early research Mr. Addison worked with Dr. E. E. Pfeiffer who was responsible for the fundamental research in composting during that period. Mr. Addison's composting experience spans forty years. Three years ago he sold his sole proprietorship and began the commercial production of compost within the present corporation, the Scarab Compost Company.

As I indicated to you in my letter of June 4, 1975, Mr. Addison and the Company have worked with Indiana State Board of Health in cleaning up the Bloomington Packing Company which was under an order to close unless it disposed of its organic refuse. The Packing Company now has a clean bill of health and Scarab composts all of the offal remaining after the meat packing process.

Mr. Addison has worked with numerous officials from the State Board of Health. Among those who may be contacted are Mr. Frank Kuhns, Field Supervisor in the Division of Meat and Poultry. Mr. Lee Parsons of the Agricultural Waste Disposal Section is also familiar with Mr. Addison's work.

Composting deserves serious and systematic consideration in preparation of the Environmental Impact Statement wherever the proposed treatment plant is to be located. One reason we have obtained the present Contract with the City is that our proposal to compost the City's sludge is the most reliable and cost-effective means of disposal. The Scarab process also offers an environmental control factor not available with other methods. Further, composting could result in a substantial savings to the City in eliminating the need to purchase land for a sludge farm operation.

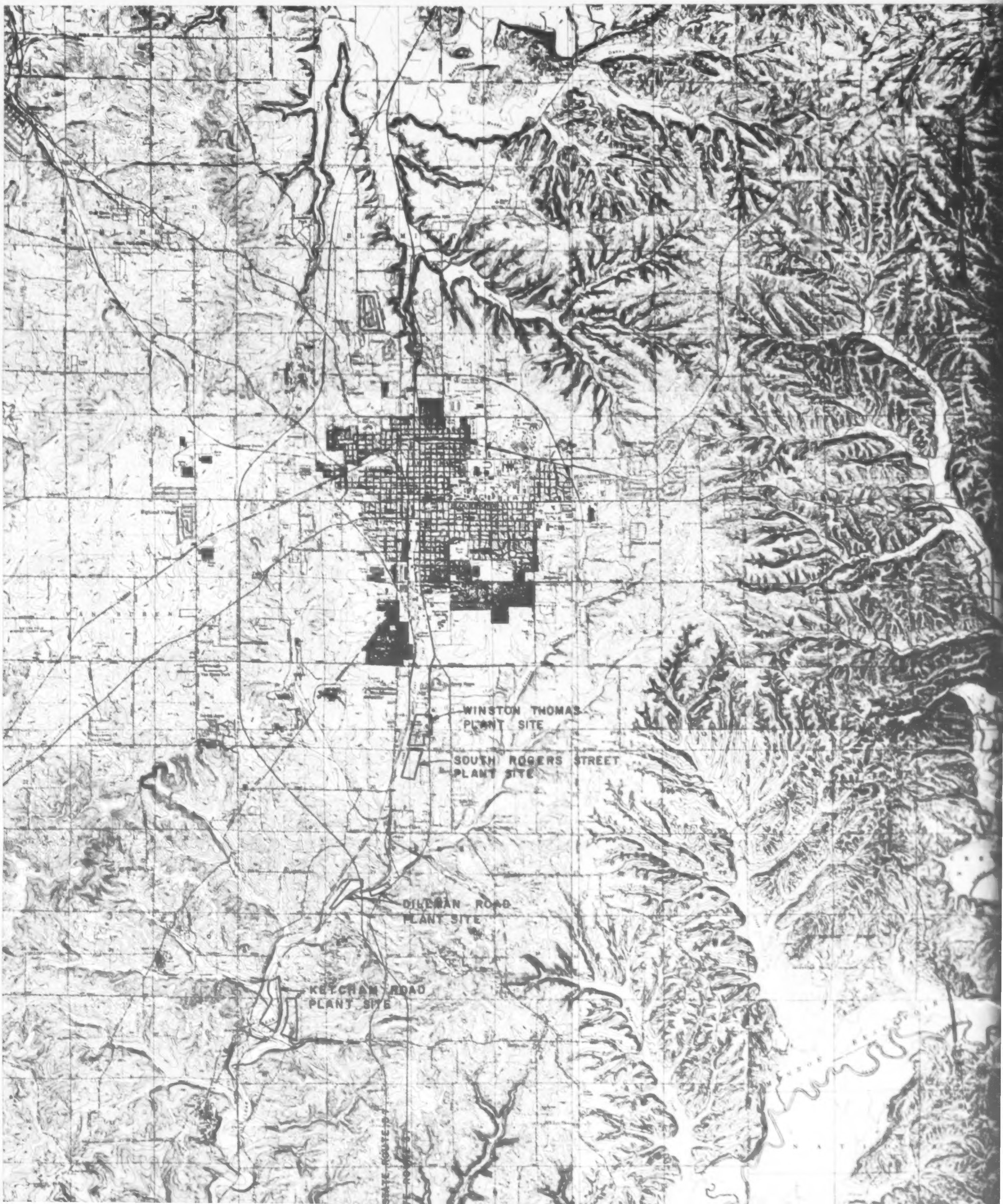
We look forward to hearing from you or your consulting engineers in the very near future.

Very truly yours,

SCARAB COMPOST COMPANY, INC.

By Edward W. Najam, Jr
Edward W. Najam, Jr., Counsel

EWN:rn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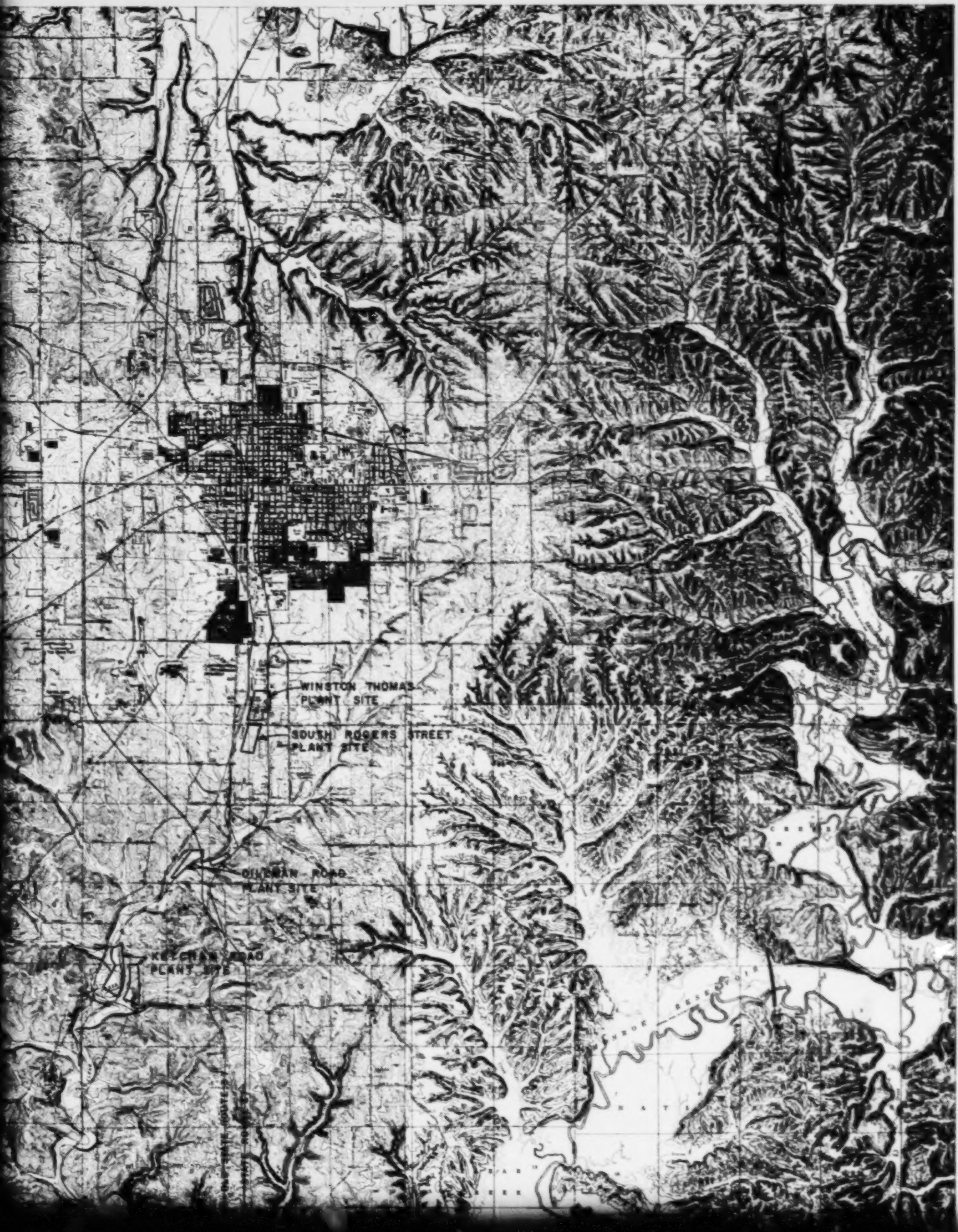
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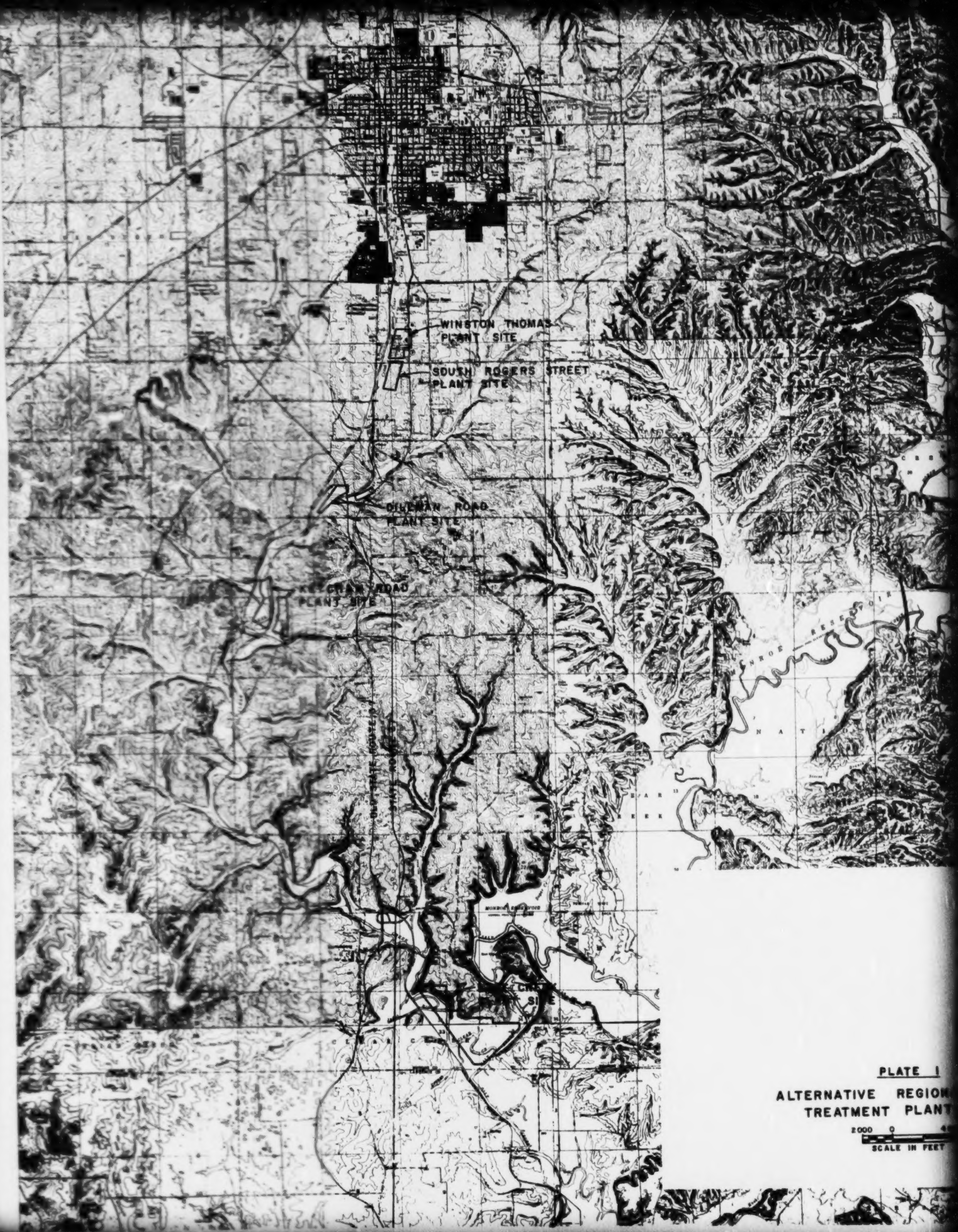
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PLATE I

ALTERNATIVE REGION
TREATMENT PLANT

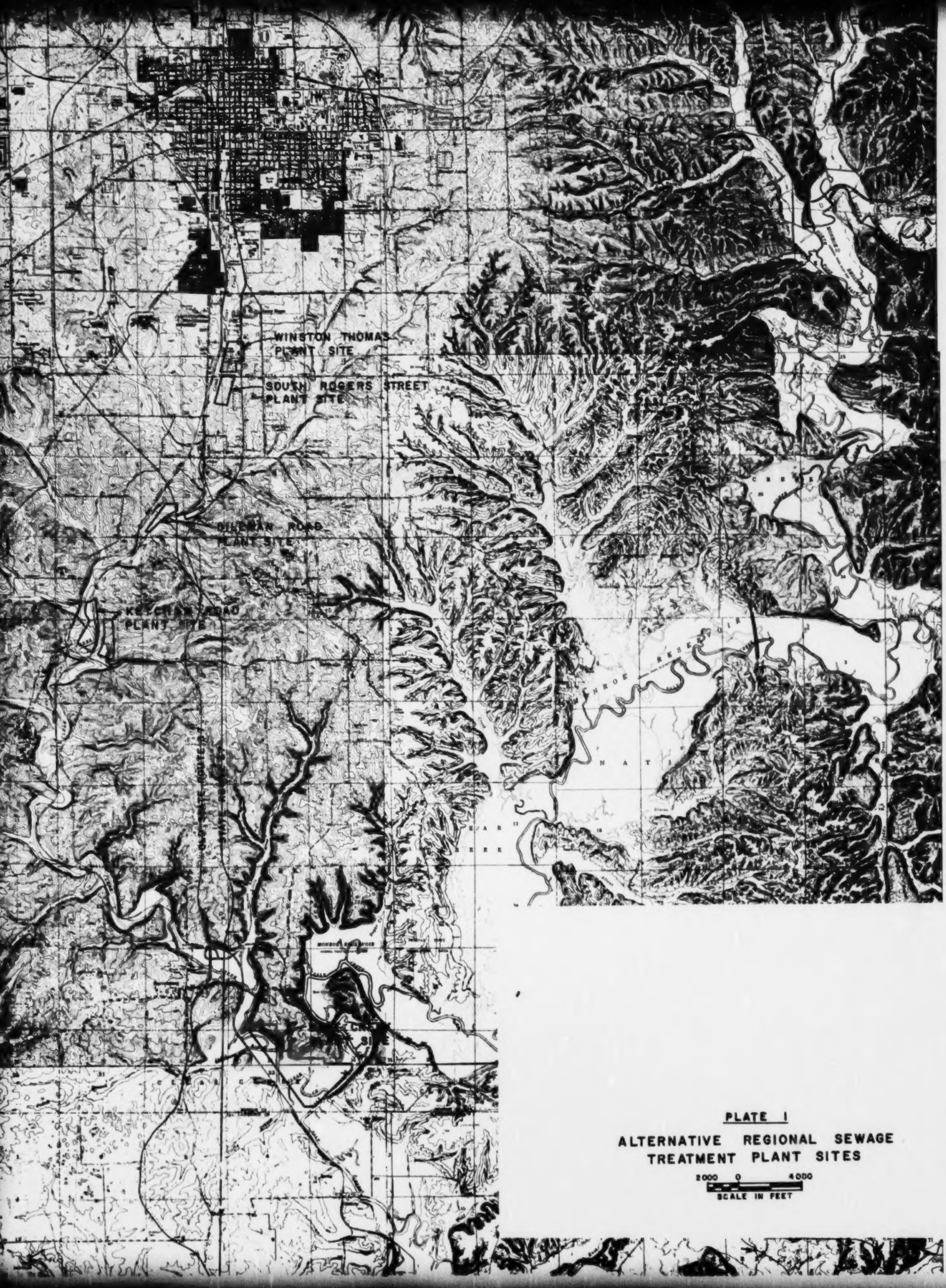
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PLATE 1

ALTERNATIVE REGIONAL SEWAGE
TREATMENT PLANT SITES

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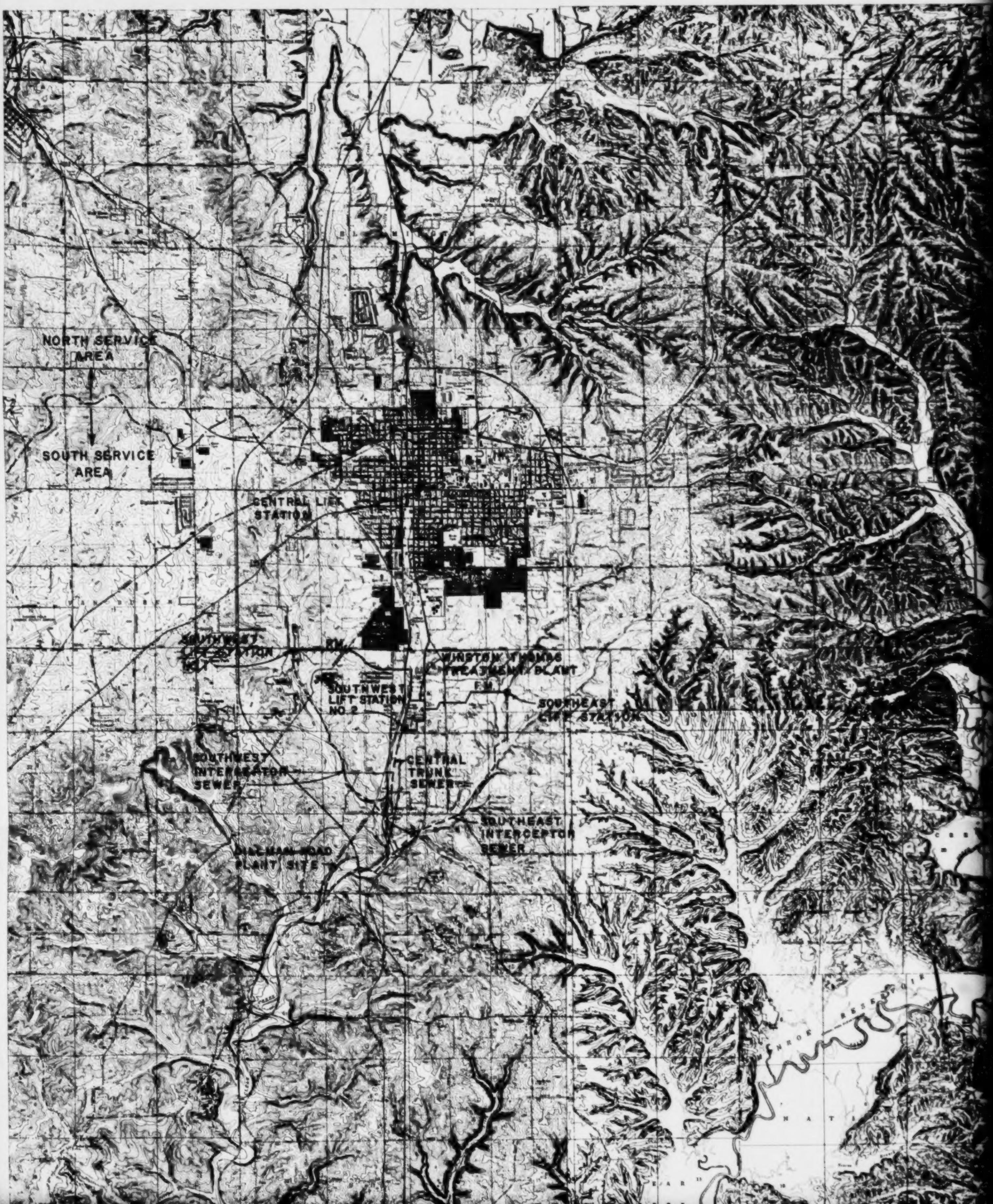
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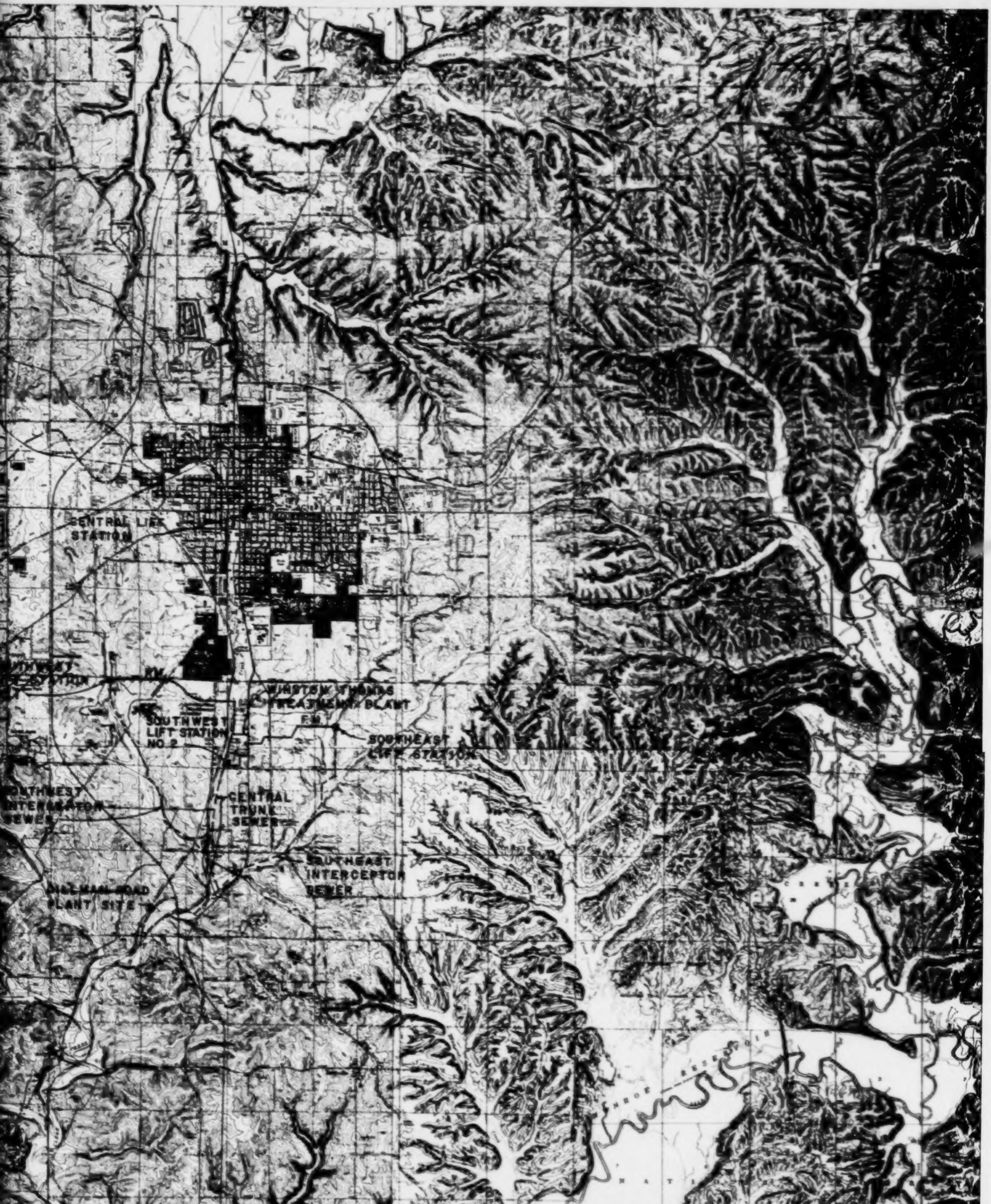

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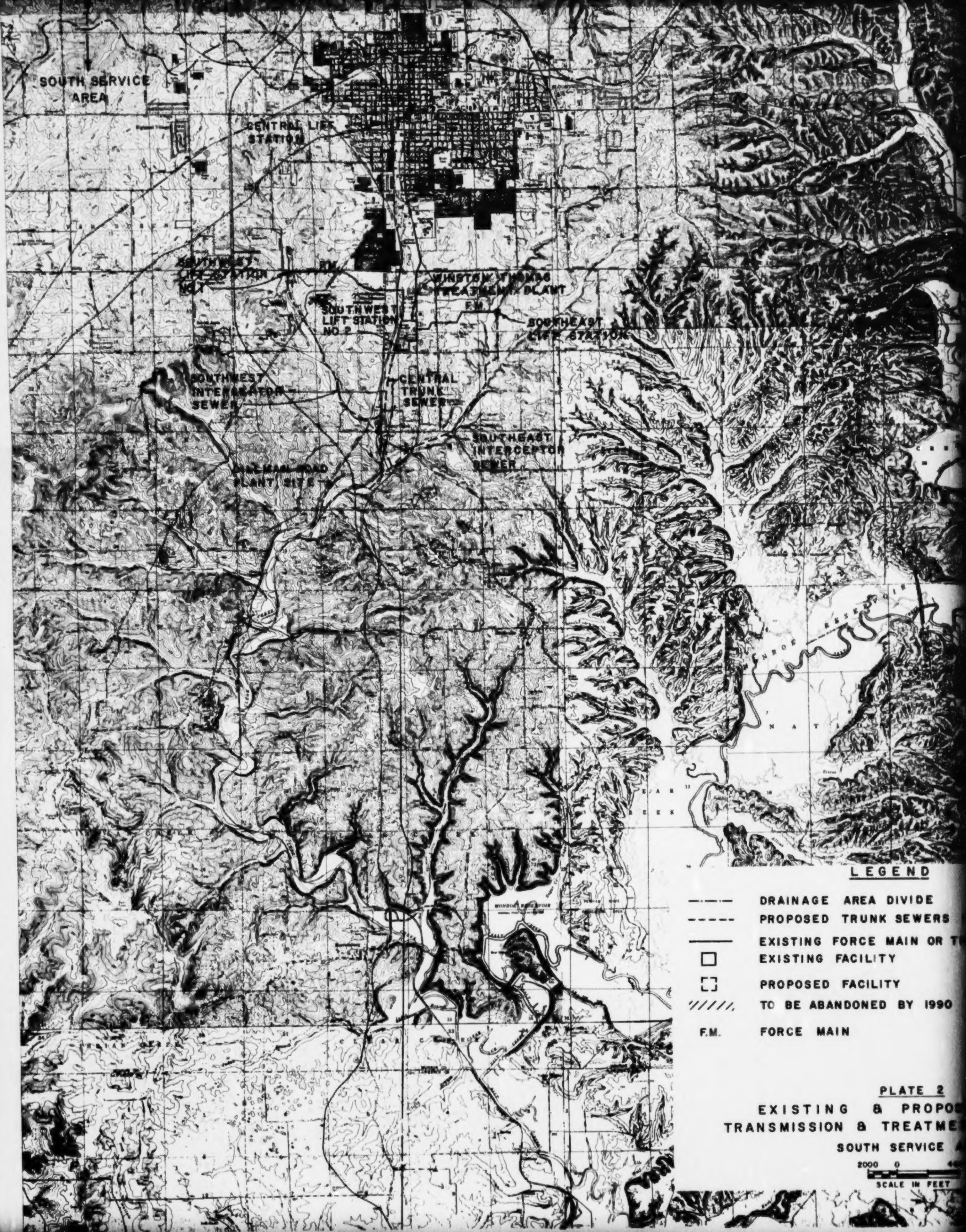
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PLATE 2

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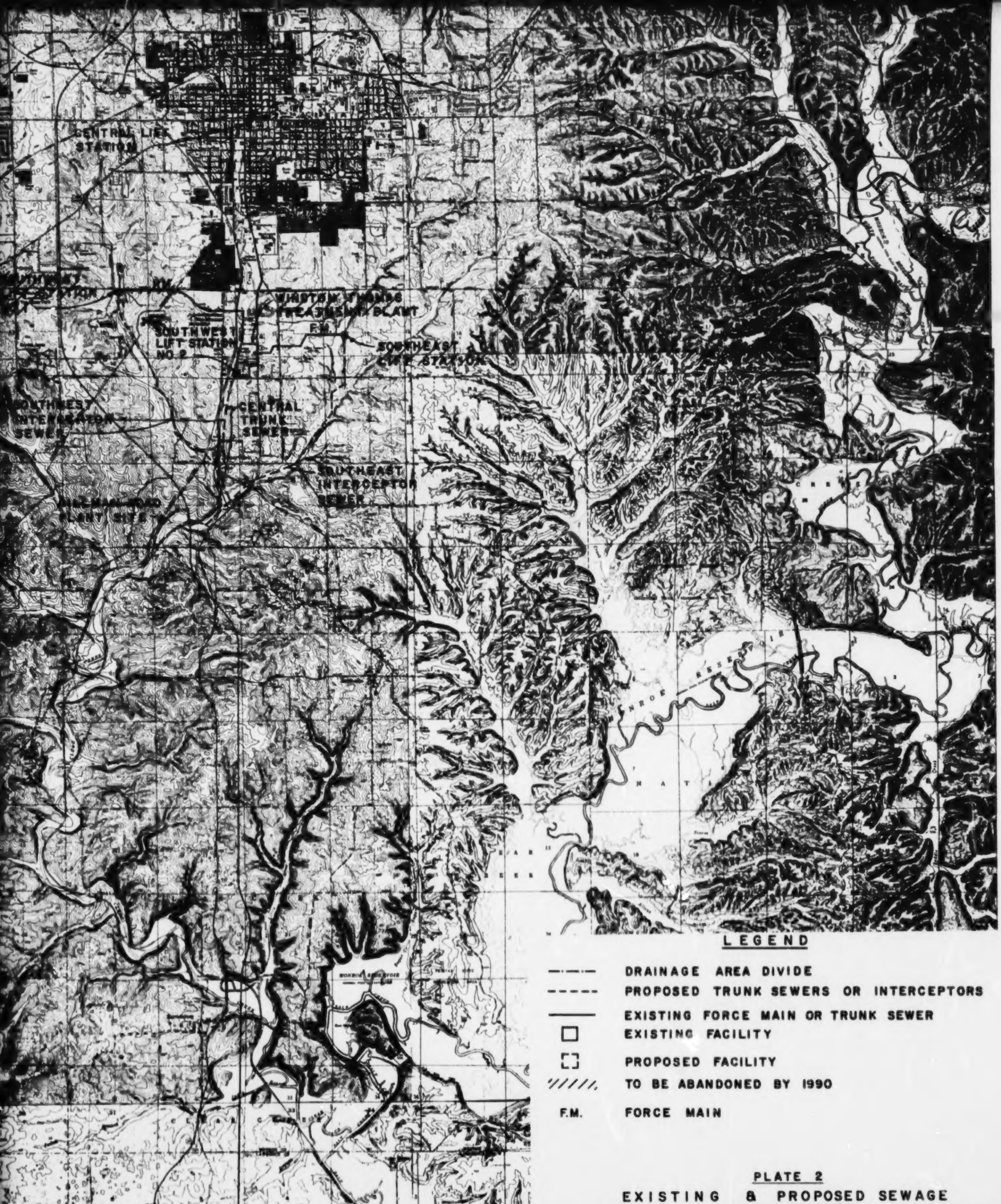
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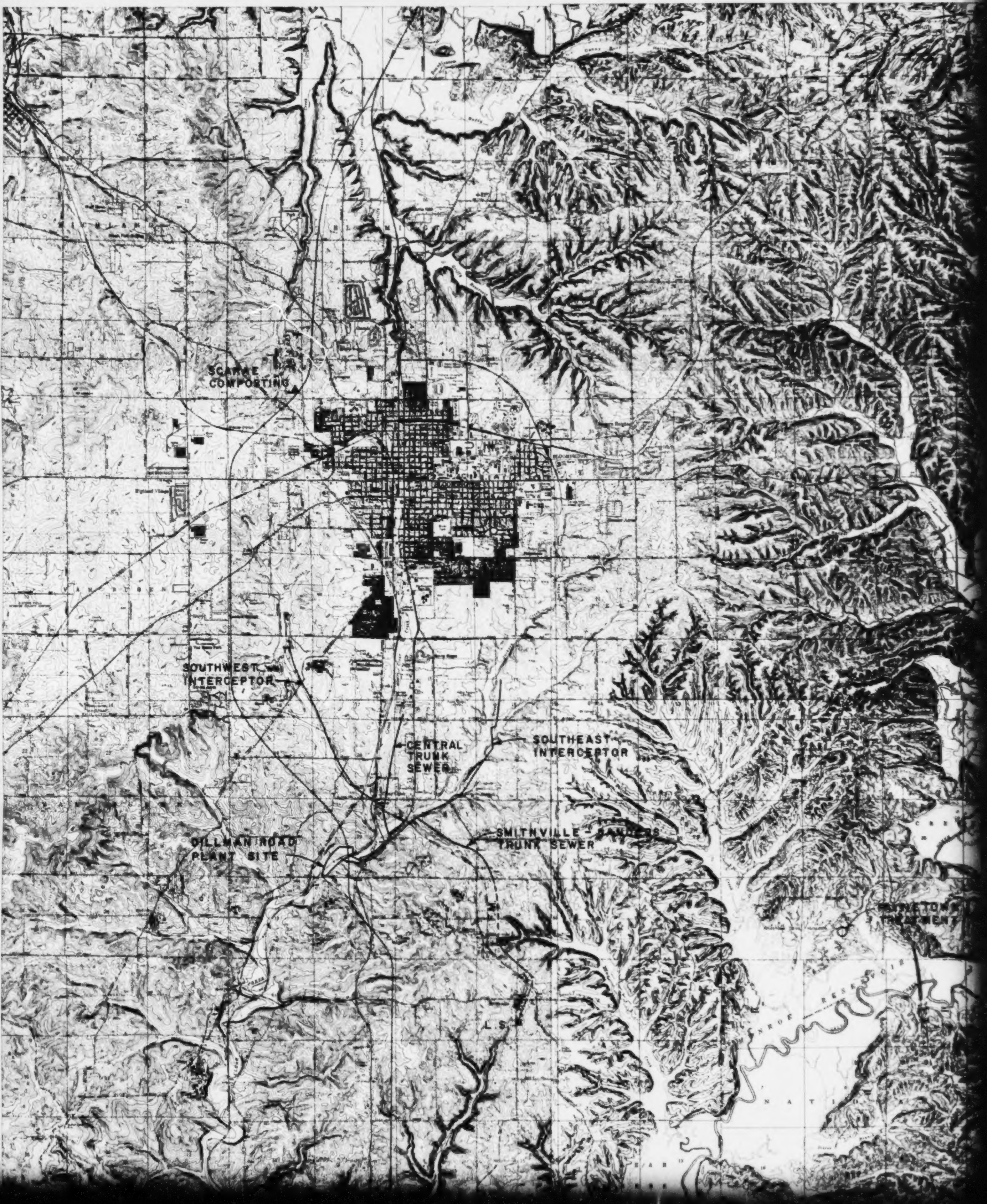
PLATE 2

EXISTING & PROPOSED SEWAGE TRANSMISSION & TREATMENT FACILITIES

SOUTH SERVICE AREA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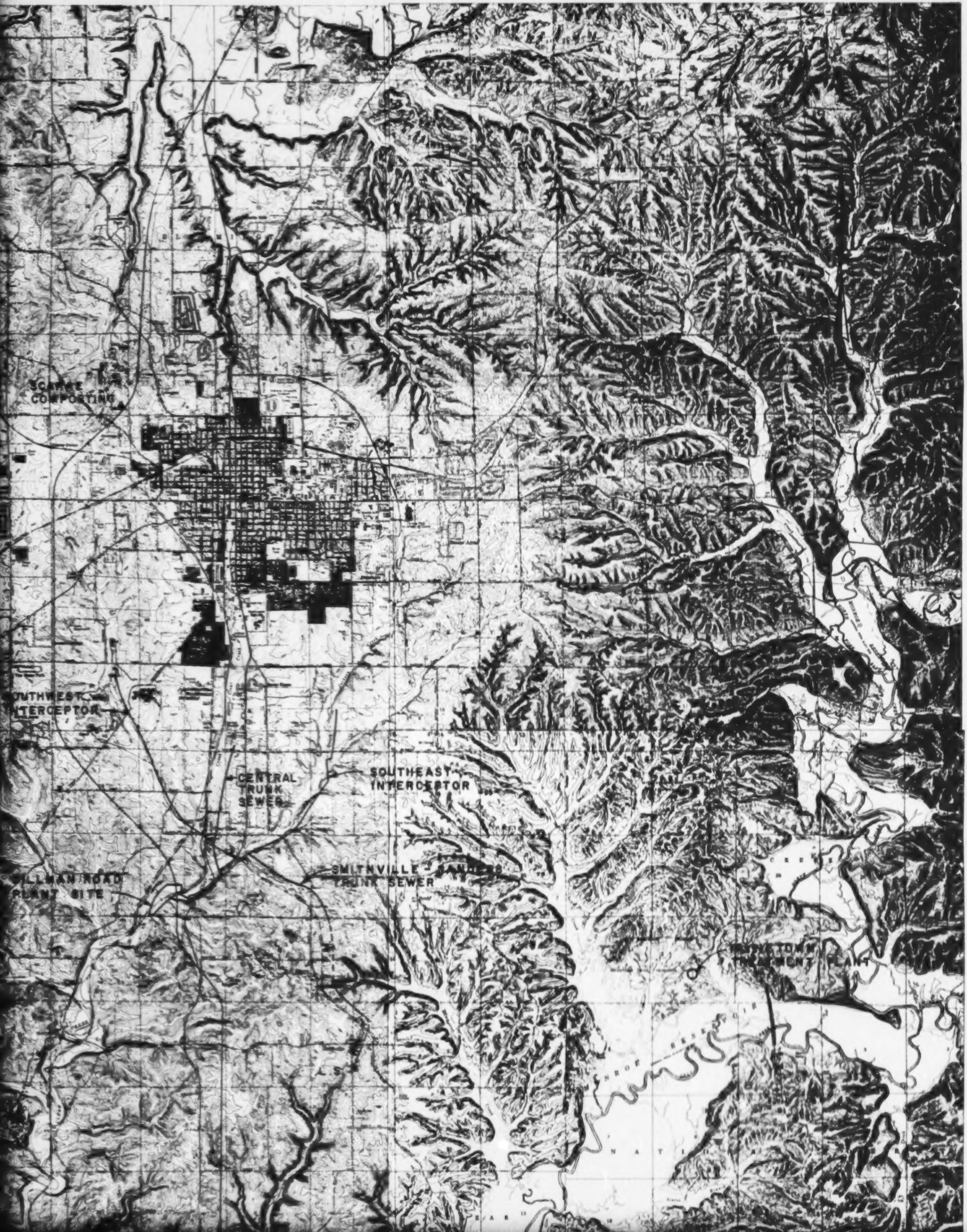
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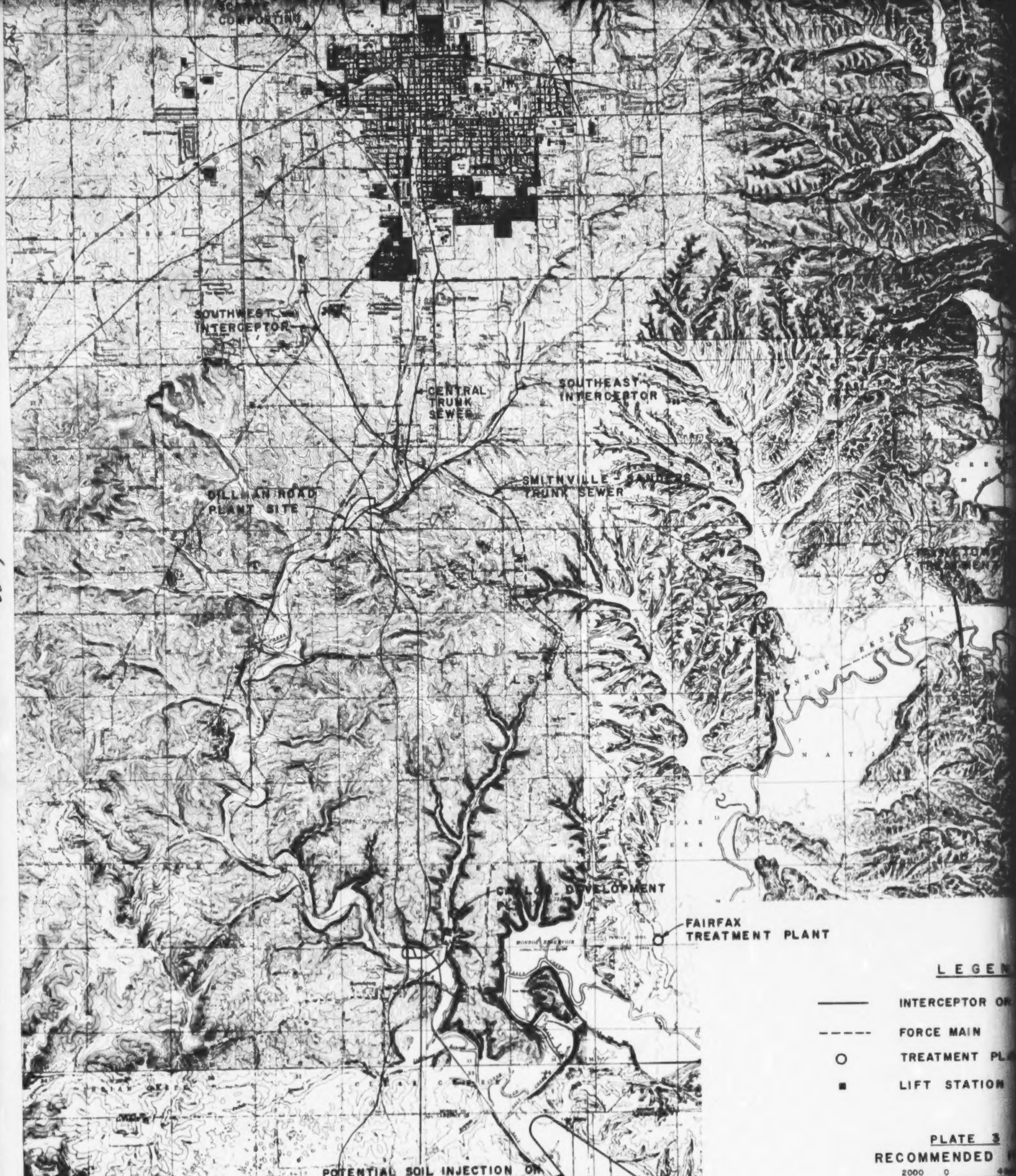
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PLATE 3

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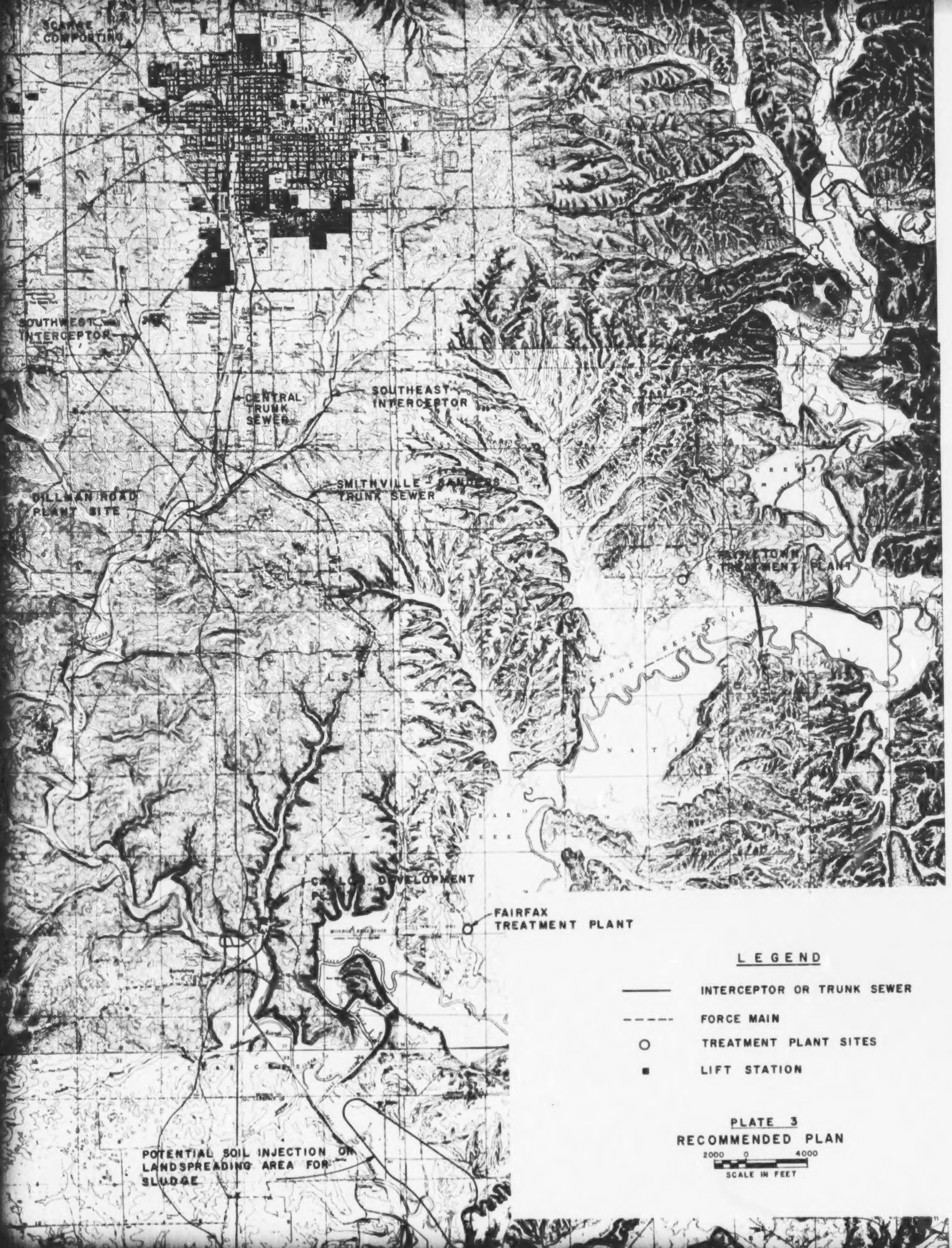
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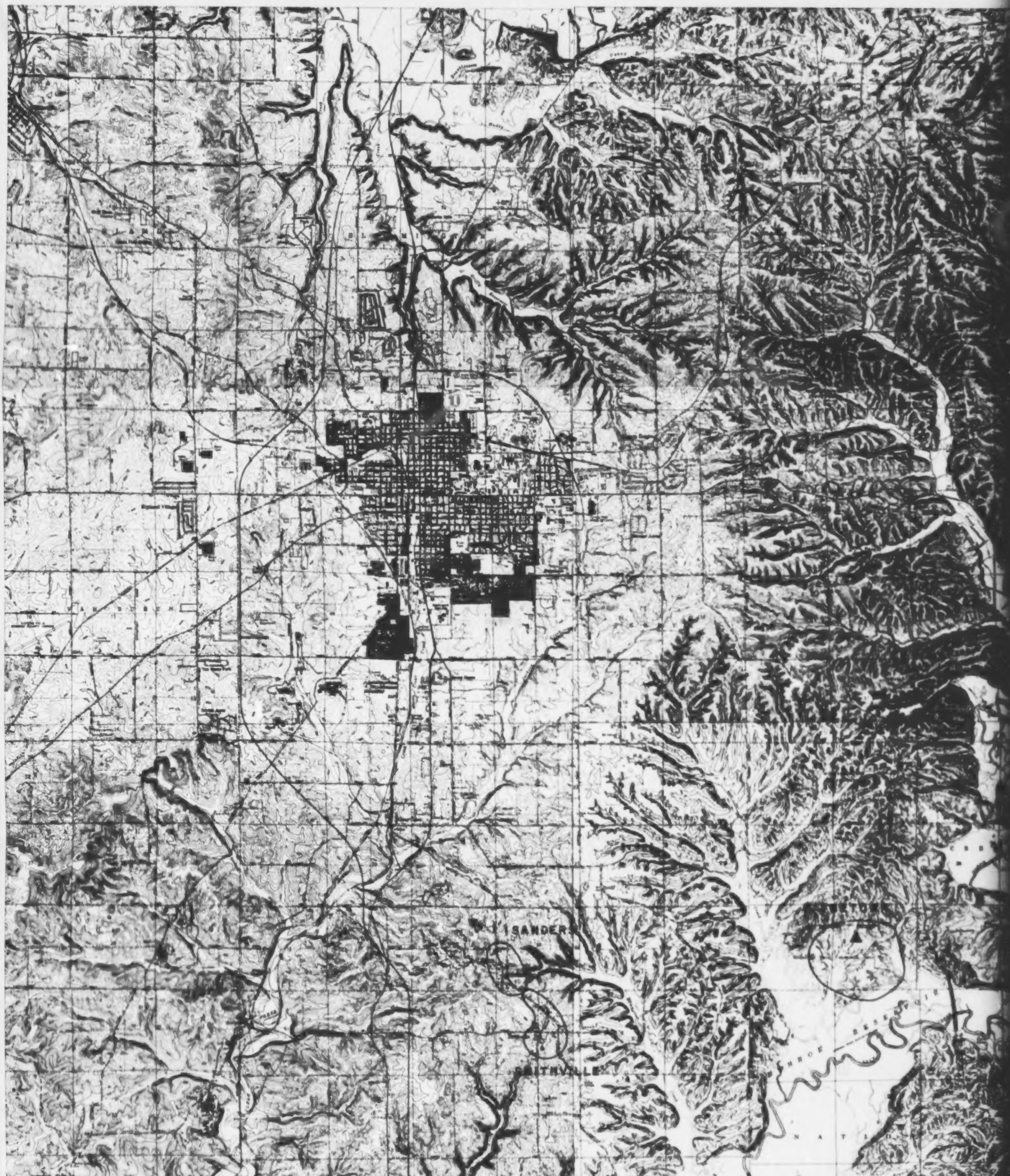
PLATE 3

RECOMMENDED PLAN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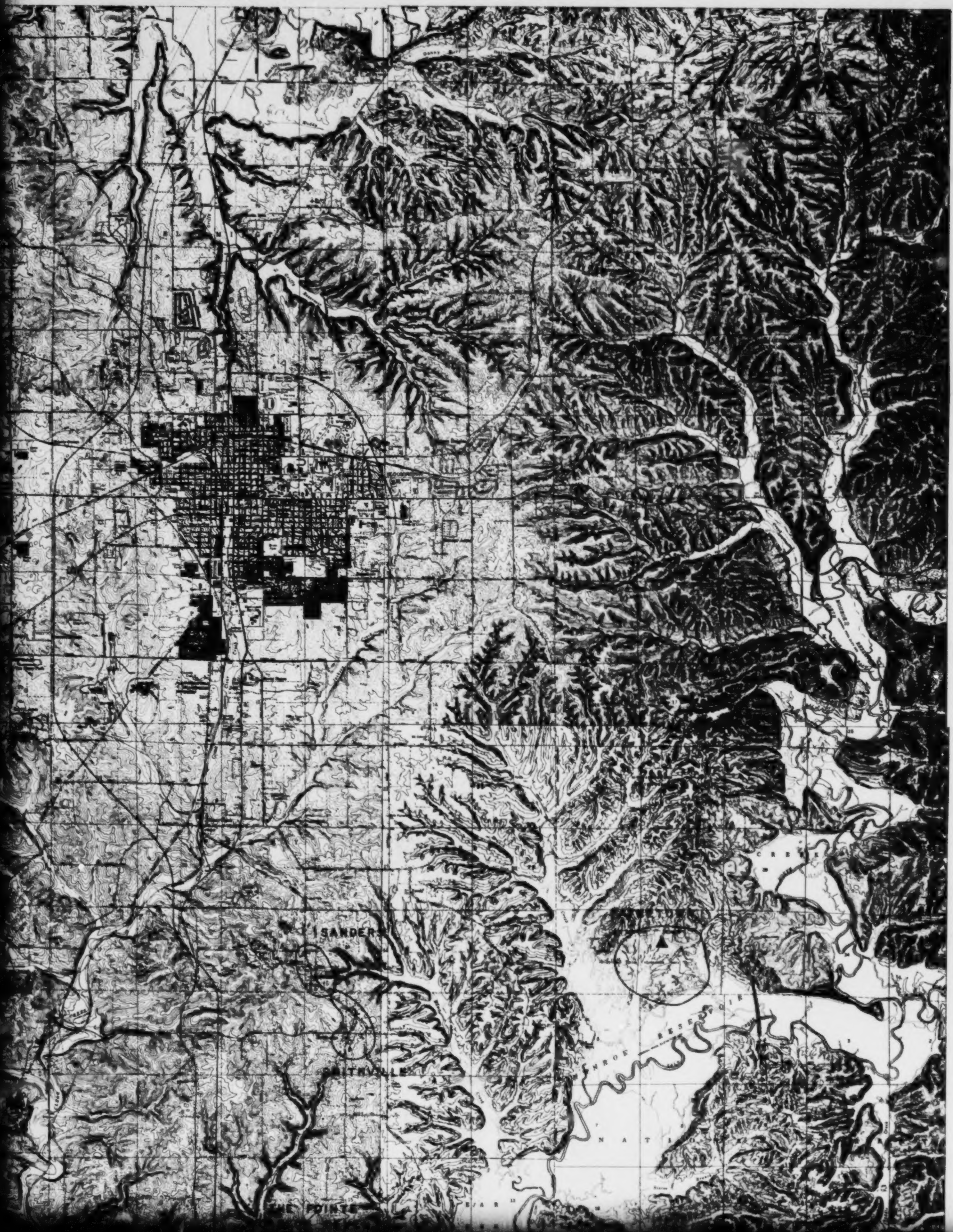
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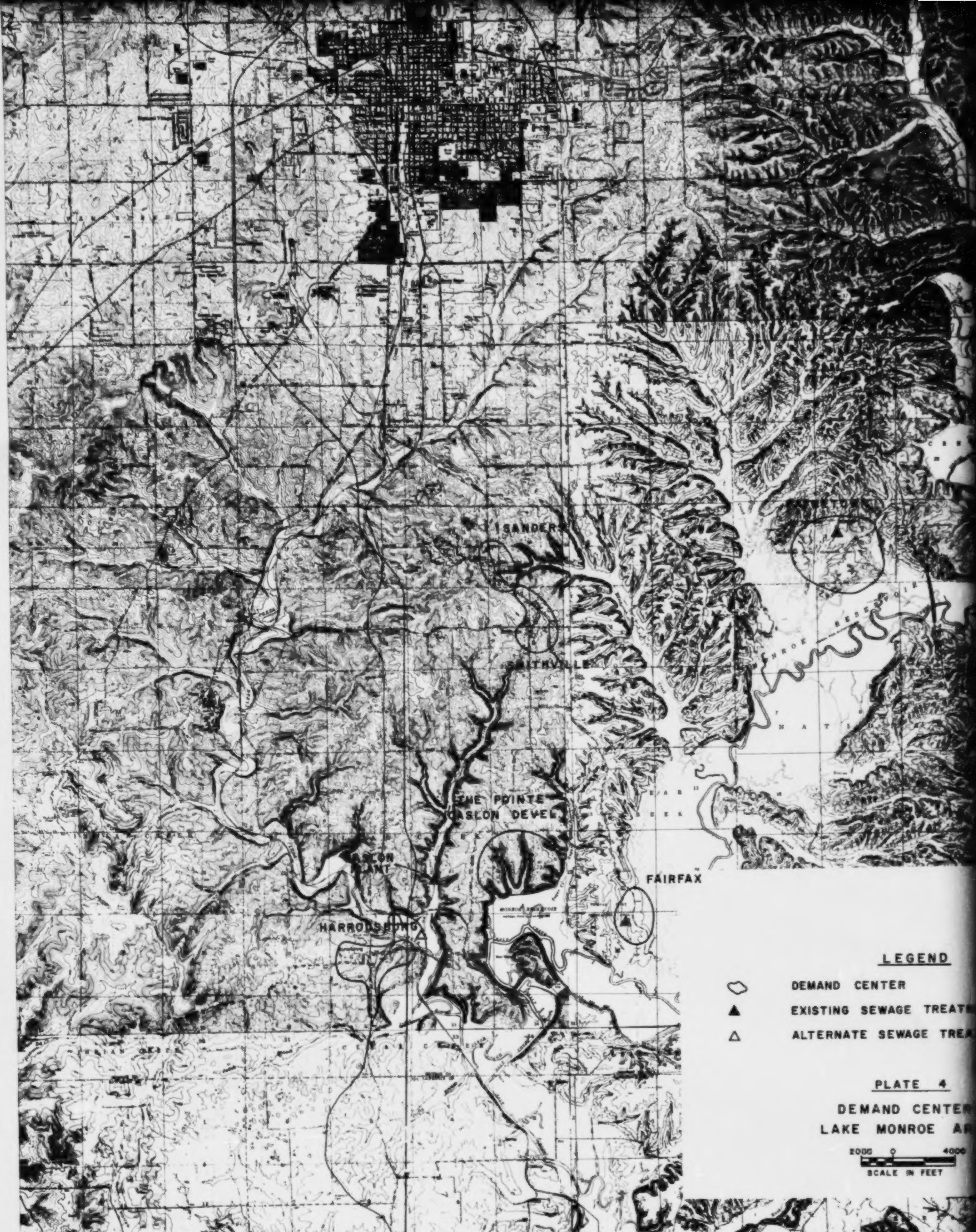
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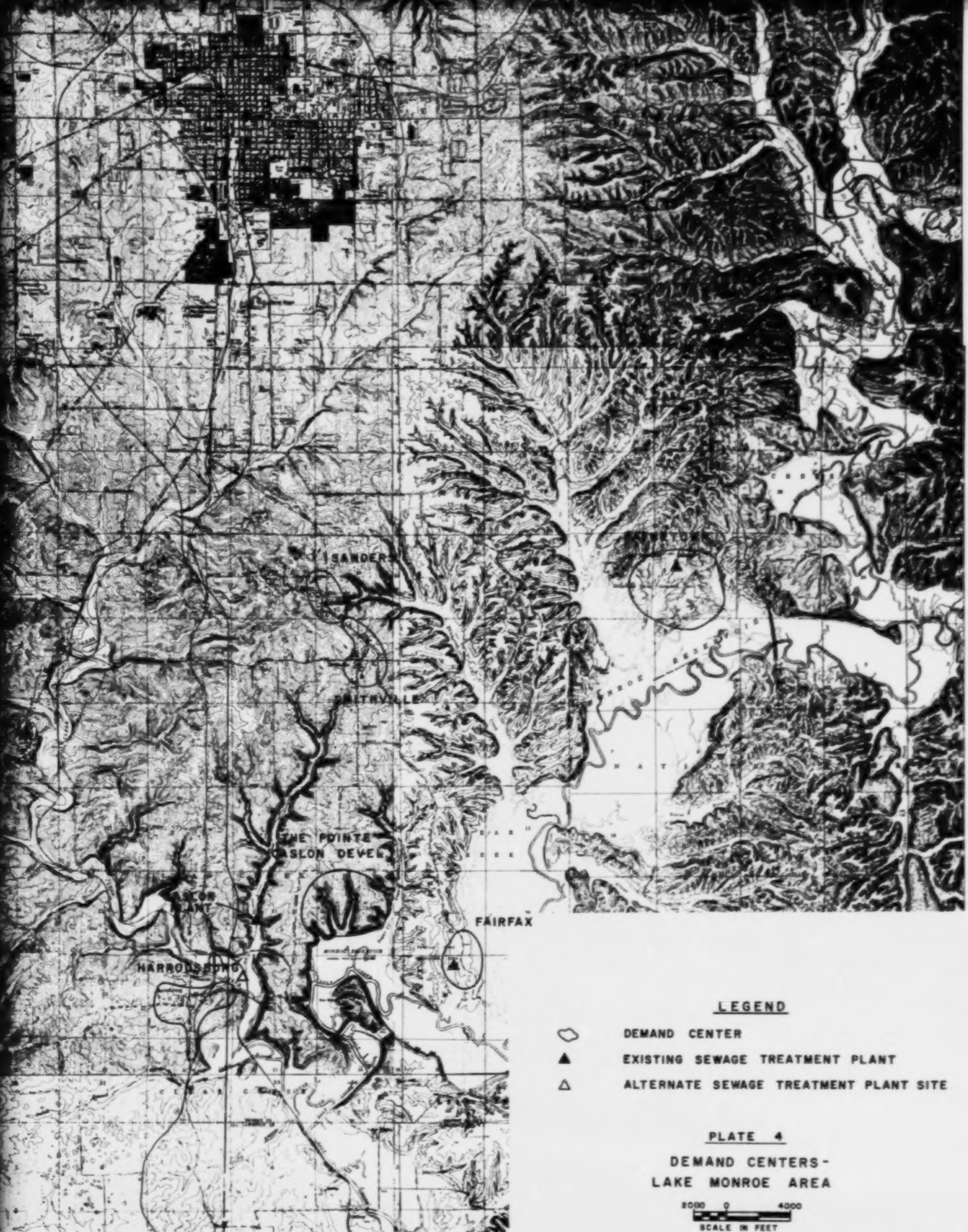
PLATE 4

DEMAND CENTER
LAKE MONROE AR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LEGEND

○ DEMAND CENTER

▲ EXISTING SEWAGE TREATMENT PLANT

△ ALTERNATE SEWAGE TREATMENT PLANT SITE

PLATE 4

DEMAND CENTERS-
LAKE MONROE AREA

APPENDIX A

PHYSICAL PARAMETERS

A. MUNICIPAL WASTE LOADS.

Data for each of the Bloomington wastewater treatment plants are shown in Tables IV-1, V-1, V-2. This data indicates the chemical and biological characteristics of untreated and treated wastes.

There is a substantial change between the recently recorded data and similar data for 1971. A comparison of the 1971 and 1973-74 data is shown in the following tabulation:

Average Concentrations

	North Plant (Blucher Poole)		South Plant (Winston Thomas)	
Year	BOD_5	SS	BOD_5	SS
1971	125	89	196	261
1973-74	164	187	137	146

The change in waste characteristics at the Blucher Poole plant may be attributed to the fact that since September 1973 waste has been pumped from the south drainage area to the north drainage area.

Reasons for the change in strength of waste at the Winston Thomas plant are not clear. There is no known significant change in industrial waste contributions. The quantity of flow during the 1973-74 period was slightly lower than in 1971, which would suggest less infiltration/inflow.

Bloomington has historically experienced problems with the operation of the anaerobic digesters at the existing Winston Thomas plant. High concentrations of heavy metals in the raw waste have been partially responsible for the operational problems. An industrial waste ordinance has been passed in recent years to allow control of industrial waste discharges.

Table IV-1

RAW WASTE CHARACTERISTICS
BLUCHER POOLE PLANT

Date	BOD	SS	DO	pH	Total Phosphate	Chlorides	Alkalinity
1973							
Jan.	105	103	3.3	7.2			
Feb.	172	185	3.2	7.3	5.2	53	
Mar.	200	106	4.3	7.3	3.5	43	
Apr.	160	140	3.5	7.2	4.3	37	120
May	140	70	2.1	7.2	7.5	42	250
Jun.	110	73	1.6	7.2	4.6	45	200
Jul.	150	75	1.0	7.1	7.4	37	206
Aug.	158	136	0.8	7.1	8.5	40	199
Sep.	171	200	0.9	6.9	10.8	36	113
Oct.	147	165	0.6	6.9	6.8	40	186
Nov.	205	431	1.2	6.9	4.5	43	180
Dec.	139	234	2.4	7.0	2.9	47	160
1974							
Jan.	158	227	2.8	7.0	3.2	72	180
Feb.	199	217	2.1	7.0	3.6	59	167
Mar.	201	261	2.4	7.1	2.9	59	171
Apr.	201	314	1.9	7.1	2.7	50	153
May	165	243	1.9	7.0	9.2	46	152

Table IV-2

RAW WASTE CHARACTERISTICS
WINSTON THOMAS PLANT

Date	BOD	SS	DO	pH	Total Phosphate	Chlorides	Alkalinity
1973							
Jan.	185	166	5.2	7.3			
Feb.	366	174	5.4	7.3			
Mar.	150	130	6.8	7.4	3.3	55	
Apr.	96	81	5.7	7.0	2.4	49	86
May	95	110	3.8	7.0	5.3	45	185
Jun.	70	98	3.7	7.1	3.3	45	170
Jul.	105	88	3.0	7.0	6.3	41	160
Aug.	106	165	2.5	7.0	4.9	46	107
Sep.	127	180	2.6	6.8	5.5	44	174
Oct.	129	174	2.8	7.0	7.5	34	212
Nov.	153	223	5.1	7.0	4.9	44	164
Dec.	118	155	4.8	7.0	3.5	57	176
1974							
Jan.	108	113	6.4	7.2	2.7	95	168
Feb.	114	137	3.9	7.2	3.2	67	151
Mar.	136	157	8.0	7.0	2.9	56	164
Apr.	133	164	5.2	6.7	4.0	51	152
May	128	159	4.7	7.0	10.8	46	159

An industrial waste monitoring program is scheduled to start in the fall of 1974. Heavy metals concentrations will be monitored as part of this program. Heavy metals concentrations in the raw waste during recent months are shown in Table IV-3.

B. RECEIVING WATER QUALITY

The receiving stream for the Blucher Poole plant is Bean Blossom Creek and for the Winston Thomas plant it is Clear Creek. The receiving stream for the new regional plant will be either Clear Creek or Salt Creek, depending on the site selected.

Data for dissolved oxygen levels in the streams above and below the existing treatment plants have been obtained by the City and are recorded in Table IV-4.

Table IV-3

CHEMICAL ANALYSES - RAW WASTE (WINSTON THOMAS PLANT)

All results in mg/l

Date	Cu	Cr	Ni	Fe	Zn	Mg	Ca
1973							
Sep. 19	0.06	0.03	0.02	0.45	0.16	7.6	54.9
Sep. 25	0.09	0.07	0.14	0.82	0.47	7.1	26.0
Oct. 3	0.15	0.18	0.21	3.10	1.99	7.6	47.1
Oct. 16	0.11	0.11	0.12	0.77	0.34	6.6	42.7
Oct. 24	N/T*						
Oct. 31	0.14	0.09	0.09	1.51	0.59	8.37	32.3
Nov. 7	N/T*						
Nov. 14	0.08	0.04	0.18	0.49	0.60	8.1	23.3
Nov. 21	0.11	0.16	0.26	0.71	0.86	8.1	29.8
Nov. 28	0.11	0.06	0.21	1.95	0.42	8.7	30.2
Dec. 12	N/T*						
Dec. 19	0.12	0.17	0.07	1.02	0.47	8.8	40.8
1974							
Jan. 9	0.12	0.15	0.10	0.73	0.33	8.4	--
Jan. 16	0.07	0	0.06	0.54	0.21	11.2	63.1
Jan. 24	0.07	0.01	0.05	0.68	0.17	10.26	70.6
Jan. 30	0.05	0.04	0.05	1.10	0.24	9.44	75.6
Feb. 6	0.09	0.05	0.06	1.7	0.40	9.44	56.4
Feb. 14	0.07	0.04	0.08	1.08	0.35	9.4	47.3
Feb. 20	0.06	0.02	0.05	0.63	0.25	8.6	32.2
Feb. 27	0.11	0.03	0.09	0.44	0.18	10.7	71.9
Mar. 6	0.06	0	0.09	0.26	0.11	9.2	66.9
Mar. 13	0.02	0	0.05	0.11	0.11	9.1	63.4
Mar. 20	0.04	0.01	0.04	0.32	0.13	9.2	78.0
Mar. 27	0.12	0.09	0.06	1.45	0.55	8.9	59.3
Apr. 3	0.11	0.08	0.09	1.65	0.50	9.7	61.1
Average	0.09	0.06	0.10	0.98	0.43	8.84	51.1

*N/T = No Test.

Table IV-4

DISSOLVED OXYGEN LEVELS IN STREAMS

	BLUCHER POOLE PLANT		WINSTON THOMAS PLANT	
Date	Above Outfall	Below Outfall	Above Outfall	Below Outfall
1973				
Jan.	13.6	13.2	13.1	9.2
Feb.	14.0	12.0	14.4	10.0
Mar.	11.9	12.0	13.0	11.0
Apr.	11.0	10.0	11.0	8.8
May	9.5	8.7	8.9	8.9
June	7.0	6.6	7.7	7.6
July	6.4	6.1	7.1	7.1
Aug.	6.2	5.4	6.9	6.3
Sep.	6.5	4.6	7.2	4.8
Oct.	6.4	4.2	7.6	5.8
Nov.	8.3	6.1	8.7	8.1
Dec.*	9.1	8.3	9.3	7.8
1974				
Jan.	12.5	12.7	10.9	10.1
Feb.	12.4	12.1	11.4	9.7
Mar.	10.4	10.2	10.1	9.2
Apr.	9.4	9.2	10.8	8.3
May	8.2	8.2	8.7	8.7

*Estimated

Table V-1

ANALYSES OF NORTH PLANT WASTE
(BLUCHER POOLE)

Date	Flow (mgd)	Suspended Solids Raw (mg/1)	Suspended Solids Final (mg/1)	BOD Raw (mg/1)	BOD Final (mg/1)
1973					
Jan.	0.41	103	18	105	10.4
Feb.	0.40	185	18	172	13.4
Mar.	0.84	106	38	200	8.8
Apr.	1.03	140	7	160	6.7
May	0.41	70	7	140	4.4
June	0.48	73	27	110	9.5
July	0.38	75	32	150	10.2
Aug.	0.45	136	23	158	9.7
Sep.*	1.44	200	27	171	5.6
Oct.	2.21	165	38	147	11.0
Nov.	2.34	431	32	205	14.4
Dec.	1.76	234	29	139	7.0
1974					
Jan.	2.59	227	21	158	6.2
Feb.	3.36	217	20	199	13.1

* Since September 1973, flow has been pumped from the south basin to the north plant through the central lift station.

Table V-2

ANALYSES OF SOUTH PLANT WASTE
(WINSTON THOMAS)

Date	Flow*** (mgd)	Suspended Solids Raw (mg/1)	Suspended Solids Final (mg/1)	BOD Raw (mg/1)	BOD Final (mg/1)
1973					
Jan.	9.1	166	29	185	40
Feb.	8.9	174	38	366	59
Mar.	10.6	130	40	150	47
Apr.	11.2	81	45	96	41
May	7.9	110	39	95	30
June	8.4	98	36	70	27
July	8.2	88	32	105	35
Aug.	7.2	165	46	106	41
Sep.*	5.6	180	34	127	35
Oct.	5.3	174	24	129	20
Nov.	5.8	223	44	153	31
Dec.**	6.4	239	58	121	19
1974					
Jan.	7.8	113	18	108	18
Feb.	7.2	137	19	114	17

* Since September 1973 flow has been diverted to the north plant through the central lift station.

** Estimated.

*** See pages A-9 to A-11 of this appendix for correction of flows due to inaccurate metering devices.

CITY OF BLOOMINGTON UTILITIES
P. O. BOX 1216
BLOOMINGTON, INDIANA 47401
TELEPHONE AC 812 339-2261

March 18, 1975

Robert Denman
Field Engineer
Municipal Wastewater Section
Indiana State Board of Health
1330 West Michigan Street
Indianapolis, Indiana 46206

Dear Mr. Denman:

Attached is a copy of work we have done checking the accuracy of our raw sewage meter.

Our work seems to indicate that the actual flow is only about 84% of the metered flow. We are contacting the meter manufacturer and hope to have them re-calibrate it in the near future.

If you have any questions on what we have done or need additional information, please contact me.

Very truly yours,

Michael M. Phillips

Michael M. Phillips
Treatment Engineer

MMP:jf

Attachment

cc:F. Beatty, Black & Veatch
G. Kent ✓
File

C. WINSTON THOMAS WASTEWATER PLANT

FLOW MEASUREMENTS

As part of our routine maintenance policy, the factory representative was contacted to inspect and calibrate our magnetic raw sewage meter.

On August 28 the meter was worked on for the first time. Because of the large increase indicated by the meter, he was called back on September 30 and October 21 to inspect and re-adjust it. Table I gives information on flows for the Blucher Poole and Winston Thomas Plants from 1973 to the present, along with the monthly measured precipitation. Graph I shows this pictorially.

To check the accuracy of the meter, three methods were used: displacement of the dosing tank, chemical gauging, and a weir.

The volume of the four dosing tanks was calculated from the blue prints and checked by addition of a known amount of LiCl. The number of times the tanks filled times their volume, was then compared to the gallons indicated by the meter totalizer for the same period of time. These values were then converted to MGD.

Chemical gauging was the second method used to check the flow. A known concentration of tracer, LiCl, was metered into the wastewater flow and samples were then collected down stream of the meter. The samples were analyzed for lithium by a model 403 Perkin Elmer Atomic Absorption Spectrophotometer, and the flow was calculated by the formula:

$$Q_u = \frac{(C_1)\ (Q_1)}{C_D} \times \frac{1440 \text{ min/day}}{3785 \text{ ml/gal}}$$

Where: C_D = downstream concentration Li mg/l

Q_1 = flow of injected stream ml/min

C_1 = concentration of injected stream mg/l

Q_u = flow MGD

Figure I shows the arrangement of equipment and sample point.

As a final test we constructed a 3 foot weir and placed it in one channel leading to the aerated grit chambers. The other side was then shut-off and all flow passed over the weir.

The comparison of the results of these three methods is as follows:

Dosing tank	84.4% of indicated flow
Chemical gauging	83.5% of indicated flow
Weir	84.6% of indicated flow.

MMP:jf

3-75

TABLE V-3

Corrected Flows

MONTH	1973 PRECIP. "	1973 W.T. FLOW*	1973 B.P. FLOW*	1973 TOTAL W.T.&B.P.*	1974 PRECIP. "	1974 W.T. FLOW*	1974 B.P. FLOW*	1974 TOTAL W.T.&B.P.*	1975 PRECIP. "	1975 W.T. FLOW*	1975 B.P. FLOW*	1975 TOTAL W.T.&B.P.
January	2.93	9.1	.4	9.5	3.83	7.7	2.6	10.3	5.16	10.4	3.6	14.0
February	2.28	8.8	.4	9.2	2.61	7.2	3.4	10.6	4.59	11.5	3.3	14.8
March	10.20	10.6	.8	11.4	4.78	8.8	3.9	12.7				
Ap	7.87	11.2	1.0	12.2	2.56	8.0	3.7	11.7				
May	4.36	7.9	.4	8.3	7.06	6.9	2.8	9.7				
June	8.38	8.5	.5	9.0	2.72	6.4	2.0	8.4				
July	5.81	8.2	.4	8.6	1.47	4.5	1.6	6.1				
August	1.39	7.2	.4	7.6	6.36	6.6	2.7	9.3				
September	1.62	5.6	1.4	7.0	8.39	11.5	3.2	14.7				
October	2.86	5.3	2.2	7.5	1.22	9.7	2.4	12.1				
November	7.09	5.8	2.4	8.2	4.52	12.3	1.8	14.1				
December	2.52	6.7	1.8	8.5	2.94	11.9	2.3	14.2				

*MGD

D. Sludge Composition

CITY OF BLOOMINGTON UTILITIES
P. O. BOX 1216
BLOOMINGTON, INDIANA 47401
TELEPHONE AC 812 339-2261

September 17, 1975

Dale Leucht
Planning
US EPA Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Dale:

The following is the information you requested:

1. Winston Thomas sludge composition in mg/kg dry weight:

Cu	980
Cr	585
Fe	5940
Ni	282
Cd	29
Zn	430

Winston Thomas sludge which is now picked up by the public for use in gardens and composting is about 65% solids.

2. Blucher Poole sludge composition in mg/kg dry weight:

Cu	690
Cr	82
Fe	2900
Cd	23
Ni	55
Zn	380

Blucher Poole sludge used for injection is about 8% solids. That used for land application is about 20% solids.

3. Enclosed is a copy of a Winston Thomas sludge test run by Purdue's Soil Testing Laboratory.

4. Tentative plans for sludge disposal at the Salt Creek Site include injection on approximately 240 acres. The Site will be divided into thirds. In a particular year one third will be injected, one third fallow, and one third farmed. We now plan to grow corn, beans, and grass.

I hope this response answers all of your questions. If not, please contact me.

Sincerely,

Richard S Peoples

Richard S. Peoples
Project Coordinator

RSP:jf

Enclosure

cc: J. Quin, Gilbert Associates
G. Kent, Blgtn. Utilities Director
F. Beatty, Black & Veatch
File

PURDUE UNIVERSITY SOIL TESTING LABORATORY -- AGRONOMY DEPARTMENT -- LAFAYETTE, INDIANA -- AES FORM 400

zc-2

SOIL TEST REPORT
for

Richard S. Peoples
City of Bloomington Utilities
Box 100
Bloomington, Indiana 47401

A COPY OF THIS REPORT HAS BEEN SENT TO Monroe COUNTY EXTENSION OFFICE.

AN EXTRA COPY HAS BEEN SENT TO:

1/16/74

IDENTIFICATION		NUTRIENT RECOMMENDATIONS *					SOIL TEST RESULTS							
								LBS. / ACRE						
LAB NUMBER	FIELD NUMBER	N LBS/A	P_2O_5 LBS/A	K_2O LBS/A	LIME T/A	SOIL-BUFFER pH	SOIL-WATER pH	PHOSPHORUS	POTASSIUM	CALCIUM	MAGNESIUM	% ORGANIC MATTER	COLOR	TEXTURE
9549	1	NO RECOMMENDATION REQUESTED				-	7.4	.050 915	.0170 210				4	5
9550	1	" " "				-	7.0	1080	210				4	5
								500ppm	100ppm					
										REPORTED WHEN REQUESTED				

Mr. Peoples:

I should explain that our analytical procedures are organized to run "partial extractions" of soils, that is, to best duplicate nutrient removal by the growing plant.

For your purposes, you are more interested in total N-P-K as reported by the State Chemists' Office for nitorganite. You would require a private lab for this work.

Divide the data as shown by 2 to obtain concentrations in parts per million, or Mg/L.

Total nitrogen is not-a part of routine soil analysis. See price list enclosed.

Eldon Hood, In Charge
Soil Testing Laboratory

*NUTRIENT RECOMMENDATIONS HAVE BEEN PREPARED FOR THE CROP YIELDS REQUESTED ON YOUR CROPPING HISTORY FORM. IF NO CROP YIELD LEVELS WERE LISTED, THEN STANDARD RECOMMENDATIONS WERE WRITTEN, THAT IS, FOR 125 BUSHEL CORN, 40 BUSHEL SOYBEAN, 50 BUSHEL WHEAT, 70 BUSHEL OATS, 6-TON ALFALFA, OR 4-TON RED CLOVER.

INFORMATION ON METHODS OF FERTILIZATION FOR EACH CROP ARE DISCUSSED IN YOUR SOIL TEST REPORT EXPLANATION SHEET.

NOTE: SOIL-BUFFER pH, THE BASIS FOR LIME RECOMMENDATIONS, IS ONLY USED WHEN THE SOIL-WATER pH IS BELOW 6.6. LIMING RATES INCREASE AS THE SOIL-BUFFER pH DROPS BELOW 6.8.

MEANING OF SOIL TEST RESULTS

SOIL TEST LEVEL	P. PHOSPHORUS TEST FOR CORN, SOYBEANS LBS. P/A	P. PHOSPHORUS TEST FOR WHEAT, OATS, PASTURE LEGUMES ETC. LBS. P/A	POTASSIUM TEST ALL FIELD CROPS LBS. K/A
VERY LOW	0-10	0-10	0-80
LOW	11-20	11-20	81-150
MEDIUM	21-30	21-30	151-210
HIGH	31-45	31-70	211-300
VERY HIGH	ABOVE 45	ABOVE 70	ABOVE 300

E. EFFLUENT LIMITS FOR THE PROPOSED SOUTH BLOOMINGTON STP.*

	Salt Creek Site	Clear Creek Site
BOD_5		
30 day average	10 mg/l	5 mg/l
7 day average	-	-
per cent removal	95%	97.5%
Suspended Solids		
30 day average	10 mg/l	5 mg/l
7 day average	-	-
per cent removal	95%	97.5%
Phosphorus		
maximum or	1.0 mg/l	1.0 mg/l
per cent removal	80%	80%
Fecal Coliform Bacteria		
30 day geometric mean	200/100 ml	200/100 ml
7 day geometric mean	400/100 ml	400/100 ml
pH Range	6.0-8.5	6.0-8.5

* NH_3 limits are on p. A-17.

STATE of INDIANA

STREAM POLLUTION CONTROL BOARD

INDIANAPOLIS 46206

1330 West Michigan Street
633-5467
xxx 5467

January 31, 1975

RECEIVED
[illegible]
BLACK & VEATCH

Mr. Gary R. Kent
Director of Utilities
City of Bloomington Utilities
P. O. Box 1216
Bloomington, Indiana 47401

Dear Mr. Kent:

Re: Nitrification Requirements for Potential
Bloomington Wastewater Treatment Plant Sites

In response to your letter of January 9, 1975, concerning the effluent ammonia nitrogen limitations for Bloomington's potential wastewater treatment plant sites, the following limits have been established:

	Existing Site or S. Rogers St. (0:1 Dilution Ratio)	Ketcham Road (0:1 Dilution Ratio)	Salt Creek (1.6:1 D.R.)	Salt Creek (2.1:1 D.R.)
BOD	5 mg/l	5 mg/l	10 mg/l	10 mg/l
SS	5 mg/l	5 mg/l	10 mg/l	10 mg/l
NH_3- N				
Summer	1.5 mg/l	1.5 mg/l	6.5 mg/l	7.9 mg/l
Winter	3.0 mg/l	3.0 mg/l	---	---

The 1.5 mg/l NH_3-N limitation is based on the best practicable technology and the other NH_3-N limitations are based on a maximum allowable toxicity concentration of 2.5 mg/l with 1.6 % un-ionized NH_3 in the stream. The 1.6:1 dilution ratio is based on a 20 mgd facility and the 2.1:1 dilution ratio is based on a 15 mgd facility.

The more rigid requirements for ammonia nitrogen limitations were outlined in a letter dated October 21, 1974, from Region V, U.S. EPA in connection with issuance of NPDES permits. The cities of Connersville, Crawfordsville, New Castle, Richmond, and Warsaw have similar restrictions.

Mr. Gary R. Kent January 31, 1975

If you have any more questions concerning this matter, please do not hesitate to contact this office.

Very truly yours,

Oral H. Hert

Oral H. Hert
Technical Secretary

MAScherer/jam

cc: Black and Veatch

Appendix B

AQUATIC ECOLOGY-LAKE MONROE

A. GENERAL INFORMATION

The situation and shape of the Monroe Reservoir appears in Figure 4.1. The area of the lake watershed is approximately 1008 Km^2 or 420 square miles, with about 80% of the runoff entering the lake through the three forks of Salt Creek (Figure 4.1). Docauer (1972) compares the population, settlements, urban development, etc. of the three major forks of Salt Creek (Table 4.1). Most available information concerns the North Fork of Salt Creek drainage system for the following reasons: (1) Nashville and its associated tourist attractions coupled with inefficient sewage treatment facilities; (2) relative size of the drainage system (almost equal to the combined areas of Middle and South Forks); and (3) relative accessibility to the University.

The effects of Nashville's sewage plant effluent can be seen in Table 4.2 from McAhron's (1972) survey of North Fork of June 19, 1972. A relative decrease in efficiency of BOD removal can be seen in Table 4.3 for the influent and effluent of the sewage plant spanning the years of 1968, 1970, and 1972.

More recently, Nelson (1974) sampled from March 19 to June 26, 1974, from six stations at regular weekly intervals to determine the actual characteristics of the North Fork water and its variation with discharge, seasonal effects, and location. A partial summary of her findings (Table 4.4) tends to show the following: (1) during high flows, before fertilization, the

Figure 4.1: Lake Monroe Basin and Watershed Map showing the permanent water sampling stations.

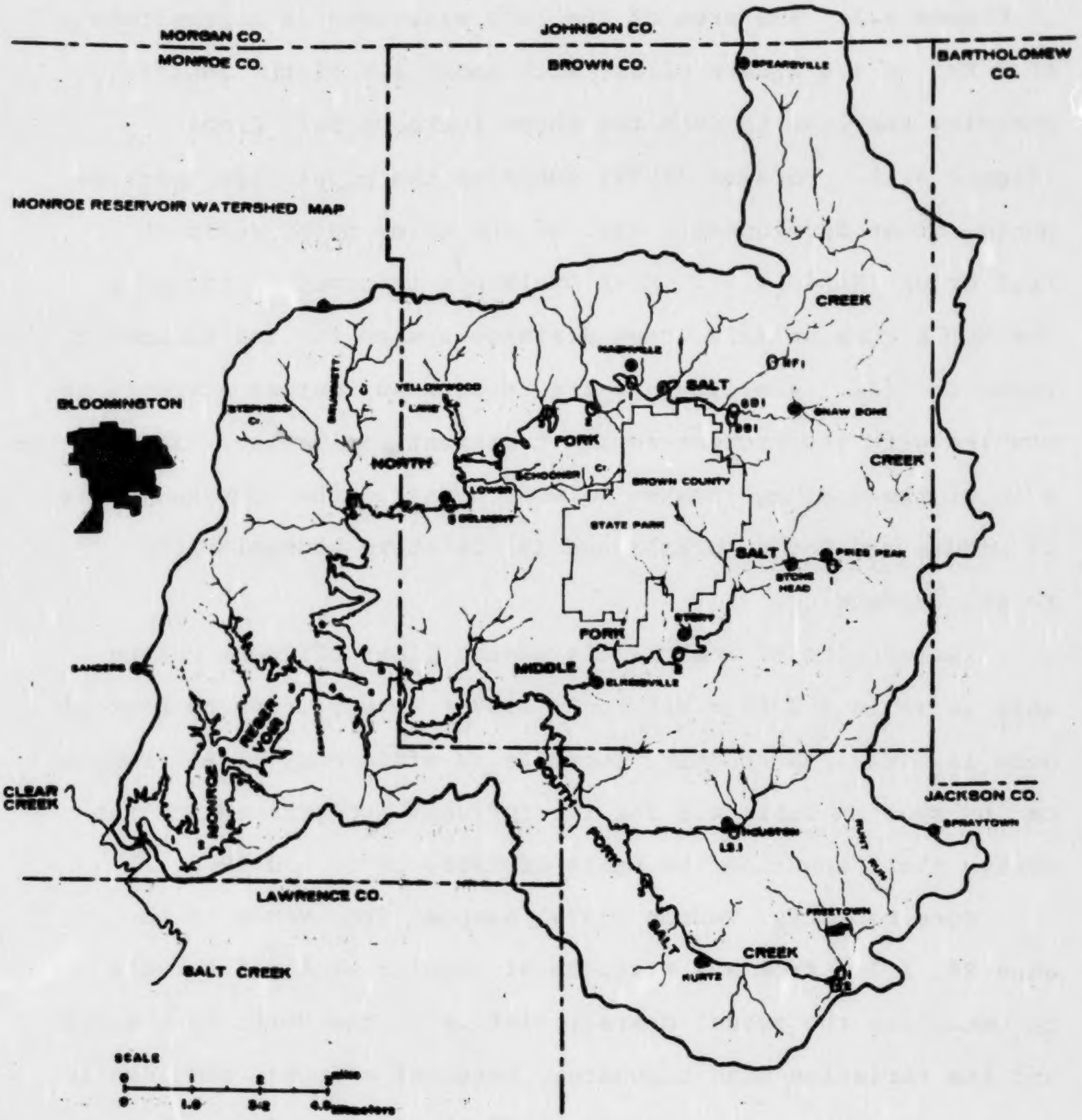

MORGAN CO.
MONROE CO.
JOHNSON CO.
BROWN CO.
BARTHOLOMEW CO.
MONROE RESERVOIR WATERSHED MAP
BLOOMINGTON
SPEARSVILLE
CREEK
NASHVILLE
BF1
SALT
SB1
SB1
GNAW BONE
CREEK
STEPHENS Cr.
YELLOWWOOD LAKE
FORK
NORTH
SCHOONER Cr.
LOWER
BELMONT
BROWN COUNTY
STATE PARK
SALT
PRIES PEAK
STONE HEAD
STORY
FORK
MIDDLE
ELKINSVILLE
SANDERS
RESERVOIR
MONROE
CLEAR CREEK
SOUTH
FORK
SALT
JACKSON CO.
SPRAYTOWN
HOUSTON
LS1
FREETOWN
CREEK
KURTZ
LAWRENCE CO.
SALT CREEK
SCALE
0 1 2 3 miles
0 1.6 3.2 4.8 kilometers

Table 4.1:

Comparison of the three tributaries of Salt Creek

Tributary	Estimated 1970 population	Number of settlements	Square Kilometers of urban development	Watershed area (Km^2)	Percentage watershed cleared	Percentage watershed publically owned
North Fork	6990	10	1.6	377	10.5	10.7
Middle Fork	950	8	0	185	16.9	27.6
South Fork	1452	8	0.4	222	30.5	17.8

(After D. Docauer, 1972).

stream maintains a high dissolved oxygen concentration and a dilution of nutrients; (2) after a peak flood on April 9, discharge then decreased; (3) after field fertilization began, obvious station-to-station variations became evident. Nutrient load, conductivity, etc. increased and the oxygen concentration decreased downstream. One might notice that the effects of the Nashville sewage plant appear masked in the overall dilution effect. However, when the water gauge reading becomes available from Nashville's gauge, the weekly discharge information will be related to nutrient concentration.

Docauer (1972), in Table 4.6, shows the fate of total phosphate from Nashville to the causeway within the lake. The spring and summer data show first the effects of dilution (spring) and also the possible increase of effluent nutrients from the Nashville plant during the tourist season of June-July.

A survey of the chemical and physical aspects of the three tributaries of Salt Creek is shown in Table 4.7 for October 2 and 29, 1974. The effects of discharge on concentration is apparent particularly at station #2 on Green Valley Road, two miles below the Nashville plant. Notice, however, that less total phosphate and soluble reactive phosphate is reaching the upper basin (#6) during this extremely low flow than reported by Docauer's Tables 4.5 and 4.6. Much utilization occurs removing these nutrients.

Interest in the upper reaches of the South Fork at #3 and #4 stations is due to the extensive farming practices present in this area. Middle Fork is of special interest since it is forested with less farming. It will serve as a "control" system in the upper head waters.

Since about 80% of the volume of yearly discharge occurs during the late winter, spring, and early summer, there is a need to concentrate most heavily on the interrelationships between nutrient loading and discharge at this time (Lee, 1969). Likewise, the overall pollution of non-point source loading needs to be investigated, since recent information shows that non-point sources are considerably greater than formerly thought (Loehr, 1974). Possible methods for controlling or decreasing the non-point sources may need to be considered.

B. PHYSIOGRAPHY OF LAKE MONROE

Monroe Reservoir is a shallow basin-shaped lake with a mean depth of 3 to 4 meters. The old Salt Creek channel meanders across the bottom as a 7 to 11 meter trench. The lake is divided into three distinct basins (Figure 4.1). The upper basin above the causeway is a shallow (3-5 meter mean depth) basin with approximately 1927 hectares area of lake surface. This basin receives the water from the three tributaries of Salt Creek. The middle basin lies between the causeway and the down stream narrows (station #5) and has an approximate mean depth of 5-6 meters. The lower basin extends downstream to the dam and has

Table 4.2:
Survey of North Fork Salt Creek near Nashville, Indiana
State Board of Health

All concentrations in parts per million (ppm) except fecal coliforms.

Station	BOD	Dissolved Oxygen	PO_4-P	NO_3-N	NH_3-N	Fecal Coliforms-#/100ml.	Total Solids
100 meters Above Sewage Plant	1.5	7.3	0.1	0.1	0.2	90	110
76 meters below Sewage Plant	4.6	6.0	1.4	0.2	0.4	20,000	170
3.2 Kilometers below Plant	1.7	5.0	0.5	0.3	0.4	11,000	100
4.83 Kilometers below Plant	1.6	5.1	0.4	0.3	0.3	386	110
7.2 Kilometers below Plant	1.6	5.0	0.4	0.4	0.3	290	110

June 19, 1972.
From McAhron (1972).

Table 4.3:
Nashville Sewage Plant, Brown County Indiana--State Board of Health Surveys

All concentrations in ppm.

Date and Station	B.O.D.	Total PO_4-P	Suspended Solids	Total Solids
June 6, 1968				
influent	490	29	----	850
effluent	120	37	----	600
efficiency	75.5%	-27%	----	29.4%
August 16, 1970				
influent	570	---	500	880
effluent	290	---	160	760
efficiency	49.8%	---	68%	13.6%
June 19, 1972				
influent	350	48	----	910
effluent	260	43	----	710
efficiency	25.7%	10.4%	----	21.9%

June 6, 1968, August 16, 1970 (Hall 1971) and June 19, 1972 (McAhron 1972).

Table 4.4:
Average monthly Chemical and Physical characteristics of North Fork Salt Creek near Nashville, Indiana from March through June, 1974. Stations correspond to Figure 1.

Date	Sta.	Oxygen % sat.	ph	$CaCo_3$ ppm	Conductivity to 20° C. µ mhos/cm.	Nitrite-N ug/l	Nitrate-N ug/l	Soluble Phosphate	Precipitation- Total for mont in inches
Mar.	1	85.1	7.0	28.0	117	1.0	509	4.0	3.87"
Apr.	1	79.2	6.4	22.3	112	1.3	445	6.0	3.49"
May	1	92.3	6.9	30.8	120	1.3	101	7.0	6.13"
June	1	82.6	7.4	40.5	116	2.8	317	2.5	1.40"
Mar.	2	84.5	6.9	24.5	115	1.0	552	5.0	
Apr.	2	78.3	6.6	21.7	110	1.7	427	7.0	
May	2	84.9	6.8	31.7	118	2.2	132	8.3	
June	2	66.2	7.4	42.7	129	7.3	304	7.0	
Mar.	4	91.9	6.9	26.3	131	1.0	580	4.0	
Apr.	4	75.5	6.6	22.8	115	3.0	438	8.7	
May	4	87.6	6.7	30.4	127	2.3	79	13.0	
Mar.	6	81.5	7.0	26.4	133	1.0	555	4.0	
Apr.	6	76.9	6.6	23.1	119	2.7	388	4.7	
May	6	84.2	6.9	33.7	131	3.5	135	6.8	
June	6	65.4	7.3	46.7	132	10.3	387	5.3	

From Nelson (1974).

**Precipitation - Summation of the averaged daily rainfall from Bloomington, Seymour, Bedford, and Columbus, Indiana.

Aquatic Ecology

Table 4.5:
Seasonal averages of inorganic (soluble reactive) phosphate in micrograms PO_4-P per liter.

Station and location on figure 1	Winter Feb.	Spring Mar.-Apr.	Summer May-Aug.	Fall Sept.-Oct.
North Fork #6	10	49.4	12.9	21.5
Pine Grove-c				
0 meters	11	28.8	4.9	18.0
5 meters	9	28.6	14.6	25.4
Causeway-#4				
0 meters	1	10.1	3.7	2.5
5 meters	1	10.1	4.8	0.0
Middle Fork (Elkinsville)	--	11.7	5.5	---
South Fork (Maumee)	--	20.0	15.4	---

From Docauer (1972).

Table 4.6:
Seasonal Averages of Total phosphate in micrograms per liter PO_4-P.

Station and location on figure 1	Winter Feb.	Spring Mar.-Apr.	Summer May-July
North Fork Nashville #1	---	17.5	84.0
North Fork Green Valley #2	---	28.0	251.0
North Fork Kent Road #6	45	79.5	144.0
Reservoir -c Pine Grove	35	52.0	149.0
Causeway #4	21	33.0	84.7
Middle Fork (Elkinsville)	---	----	89.5
South Fork (Maumee)	---	----	163.0

From Docauer (1972).

Table 4.7:
Chemical and Physical characteristics of the three Tributaries of Salt Creek during October, 1974.
(A= Oct. 2 and B= Oct. 29, 1974)

Station	Date	Temp. (°C.)	pH	Alkalinity (meq)	Conductivity (µmhos-20°C.)	Dissolved Oxygen-ppm	Sol.React. PO_4-ug/1	Total PO_4-ug/1	Ammonia ug/1	Nitrate ug/1	CFS
#6	A	10.5	7.6	1.61	150	7.7	9.8	29.2	46	271	--
#6	B	13.0	7.2	1.52	225	1.8	5.5	----	15	72	--
#2	A	10.0	7.6	1.49	151	8.2	40.5	82.0	147	253	39.3
#2	B	12.6	7.2	1.30	200	2.5	219.0	----	1300	55	6.9
#1	A	10.0	7.7	1.82	152	9.8	3.0	16.0	29	167	gaged
#1	B	12.9	7.3	1.12	188	7.7	2.7	----	9	75	gaged
#NF1	A	10.0	7.5	1.83	137	9.9	1.9	12.2	24	227	----
#NF1	B	12.8	7.3	1.00	160	7.8	1.4	----	14	40	4.2
#SB1	A	10.3	7.6	1.61	187	12.0	1.3	2.6	21	682	3.2
#SB1	B	13.5	7.3	0.95	200	8.7	1.0	----	8	187	0.8
#DB1	A	11.3	7.6	1.36	137	10.3	3.0	6.2	39	720	1.1
#DB1	B	15.0	7.2	1.64	210	3.7	3.3	----	39	210	0.02
#MF1	A	11.3	7.5	1.22	173	9.9	0.9	8.0	23	126	3.9
#MF1	B	13.8	6.9	0.71	176	8.0	1.0	----	5	95	1.9
#MF2	A	10.4	7.6	1.34	158	8.9	1.4	11.3	28	910	8.6
#MF2	B	12.8	7.2	0.82	189	6.6	2.4	----	41	380	1.8
#LS1	A	10.2	---	----	140	9.7	1.1	3.5	25	10	3.5
#LS1	B	14.0	7.2	0.64	160	7.5	1.4	----	5	70	2.6
#SF1	A	10.0	7.6	1.48	181	9.3	5.2	21.3	54	835	13.7
#SF3	B	14.5	7.2	0.87	280	10.3	2.0	----	13	140	2.5
#SE4	B	15.5	7.4	1.31	240	10.8	2.4	----	20	430	0.1

an approximate mean depth of 7-8 meters. The surface area of the combined lower basins is approximately 2875 hectares. (For more information see Table 4.8).

Four main, interdependent categories of physical factors control biological production in Lake Monroe, as in all natural waters. They are associated with (1) radiant energy input, (2) nutrient input and loss, (3) oxygen supply, and (4) interactions of morphometry and motion (Mortimer 1969).

On a global scale, variables related to solar energy appear to have a greater effect than those related to nutrient availability. This solar energy is a key factor in driving wind-induced and convective circulation, regulating water temperatures, and governing local climatic conditions. However, when restricted latitudes are considered, factors related to nutrient availability assume a much greater importance.

A comparison of the watershed to lake surface area yields a ratio of 25/1 for Lake Monroe. Vollenweider (1971), using information from various sources, has shown that the "surrounding factor" (drainage area/lake surface) and primary production in European lakes are strongly correlated. Obviously, lakes with a large "surrounding factor," or with a high nutrient input, or both, will be greatly enriched by nutrients from the watershed. As these nutrients enter the lake, their dilution will be governed by the total volume of the lake. Since temperate lakes are notorious for stratification and incomplete mixing, Vollenweider suggests that the mean depth (relating volume to unit surface area) as an index of the biological effectiveness of loading is, at present, the best compromise. The relative shallow mean depth of Lake Monroe forces one to consider the statement made by Brylinsky and Mann (1973: 1-15) which reads, "However, if one wished to make comparisons on the basis of production per unit volume, the shallower lakes would be more productive and would be expected to have a more dense phytoplankton population. Hence, it is reasonable to think of shallow lakes as compressed versions of deep lakes, in terms of productivity per unit area." The relatively shallow basins found in Monroe Reservoir must be regarded as an important factor in all future considerations.

C. PHYSICO-CHEMICAL PROPERTIES OF LAKE MONROE

The chemical and physical methods of water analysis are shown in Table 4.9. Methods not included in this table are discussed within the text.

1. Transparency

Secchi disc readings obtained from June to October 1974 are shown in Figure 4.2. This figure suggests that there is a significant increase in transparency from the months June to August. Following a decrease in September, transparency slightly increased in October. Maximum Secchi disc transparency occurred

TABLE 4.8:

The following data have been converted or calculated from figures reported in Report #9, Indiana Flood Control and Water Resources Commission, 1956.

Stream Gaging Stations in Salt Creek Watershed

Location	Drainage Area Sq. km.	Period & Record	Discharge,m^3/sec.		
			Mean	Max.	Min.
Salt Creek near Peerless	1507	1939-1950	19.2	577.9	0.02
Salt Creek near Harrodsburg	1142	1955-1956	11.2	133.1	0.03
North Fork of Salt Creek near Belmont	311	1946-1956	133.1	430.6	0.

Annual Precipitation:	Mean	Max.	Min.
	1.06m	1.54m	0.72m

Storage Capacity:		
	Total	.55 km^3
	for flood control	.32
	for increasing low flow	.20
	for sediment storage	.03

Total volume corresponds to 0.482 meters run off from drainage area of 1142 sq. km.

Maximum flood control pool elevation	169.5m
Normal pool level	164.3m
corresponding to a pool of	43.3km^2
Sediment storage below	157.0m
Approximate mean depth (max.)	7m
Approximate mean depth (min.)	4m

in late August and agreed well with measurements in 1968 and 1971 by Zimmerman and Allanson. Transparency increased from the upper basin to the lower basin with an increment of 0.3 to 1.1 meters. The high variance occurring in late July and August is due to fluctuations of phytoplankton species abundance and biomass. The high variance shown in September and October is contributed to by rapid climatic changes.

A set of extinction curves for sunlight versus Secchi disc readings is given in Figure 4.3 for Station 4 and Station 1 from July to October. The one percent level of transmission occurred at 4.5-8.5 meters during this period. The simultaneous Secchi disc reading was calculated and it demonstrated that the disc disappeared at 10 to 25 percent of surface illumination. Allanson et al. (1973) suggested that this was due to extensive scattering of light by particulate material.

A comparison of Secchi disc readings from 1968 to 1971 with data from this study is given in Table 4.10. The means and their standard deviations suggest that no significant change in transparency occurred in these years, but a decline in the mean transparency for 1974 was found. Two possible explanations could be given: (1) an increase in planktonic production as a result of nutrient additions, or (2) an increase in soil deposit and non-biological particulate matter. It should be noted that similar patterns of weed distribution were found, so the competitive interactions would remain of roughly the same magnitude and no increases in phytoplankton from this phenomenon would result.

Figure 4.2:
Seasonal changes of Secchi disc readings.

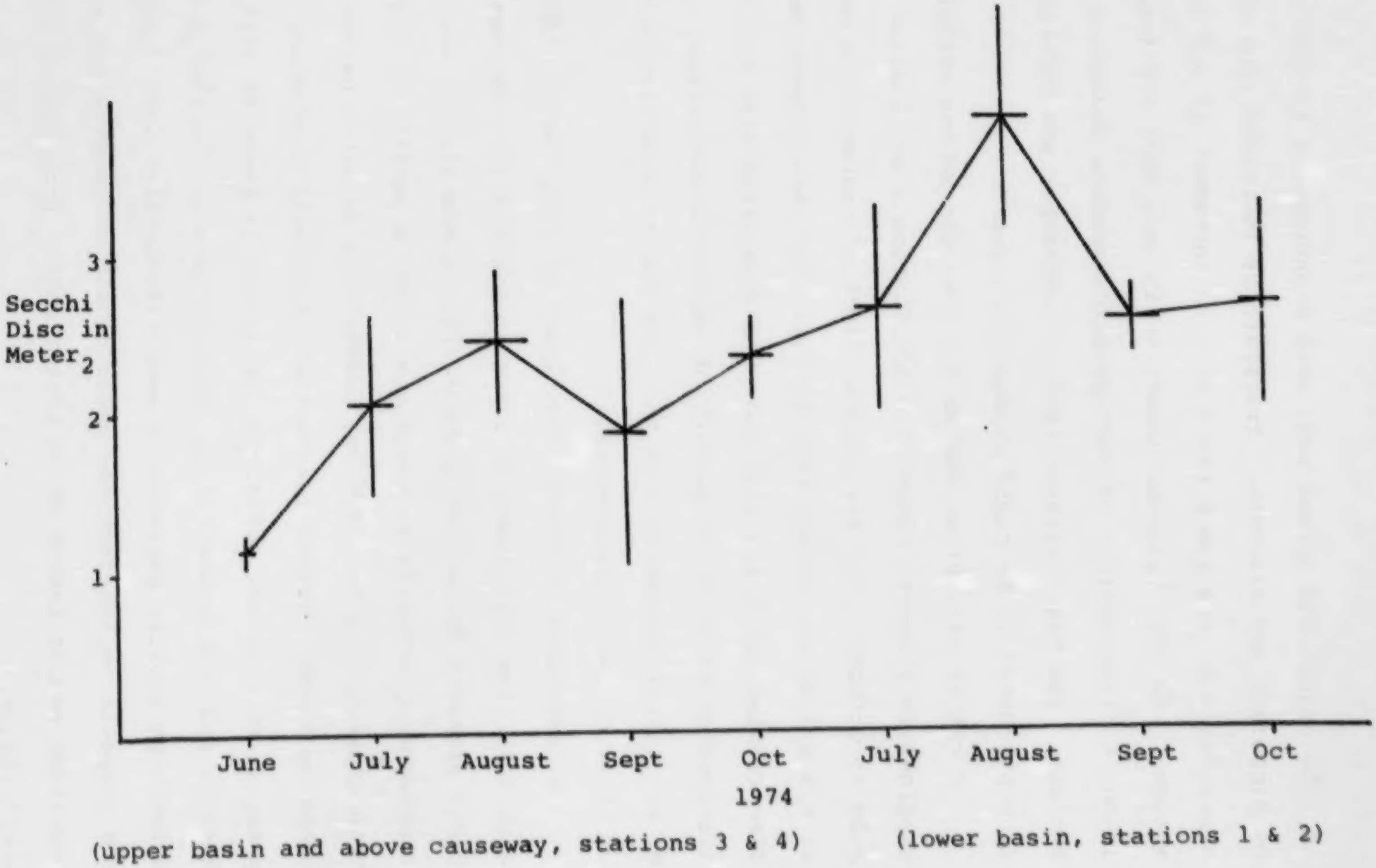


Figure 4.3:
Extinction curves for sunlight at two stations in Lake Monroe, June to October, 1974.
Secchi disc transparencies are recorded as perpendicular lines.

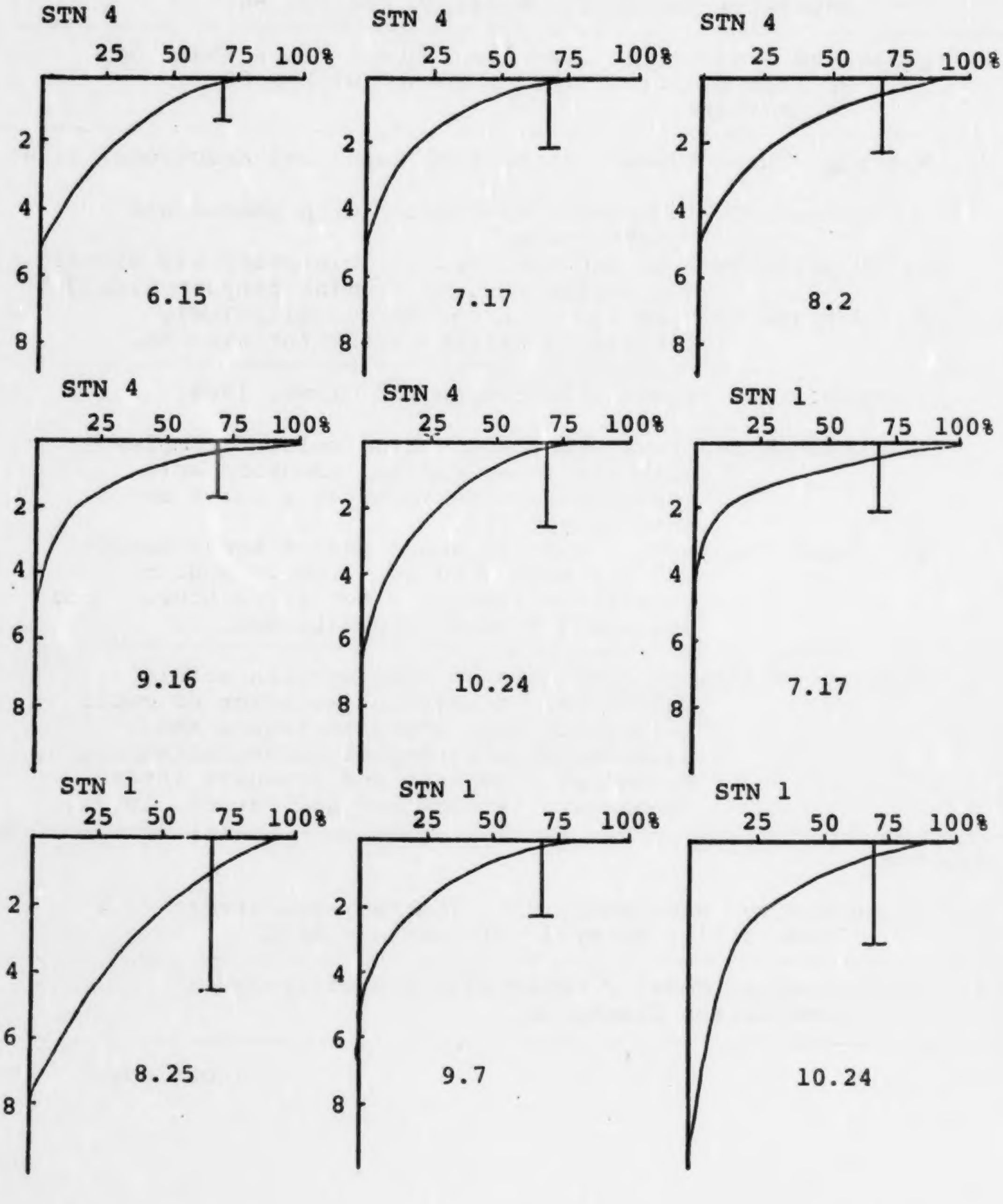


Table 4.9:
Chemical and Physical Methods of Water Analysis

A. Chemical

1. Alkalinity (methyl orange alkalinity) - using 0.01 N sulfuric acid with pH determined end point of 4.4 pH. This gives milliequivalents (meq). To determine ppm $CaCO_3$, multiply meq. by 50.

2. Dissolved Oxygen- YSI Dissolved Oxygen Meter Model 54 or Azidemodified Winkler Method with N/80 Thiosulfate.

3. Nitrogen-Three types: (Stainton, Capel and Armstrong, 1974)

   A. Ammonia-N- indophenol blue color with phenol and hypochlorite.
   B. Nitrite-N- pink azo dye; reduce quantitatively nitrate N-1 Napthyethylene diamine dihydrochloride.
   C. Nitrate-N- Pink azo dye; reduce quantitatively nitrate to nitrite-treat for nitrite.

4. Phosphate-Two types: (Golterman and Clymo, 1969)

   A. Soluble Reactive Phosphate - blue colored complex with acidic molybdate, ascorbic acid reductant and antimony as a color enhancing species.
   B. Total Phosphate - same as above except treat sample (25 ml) with acid and 1 gm potassium persulfate-autoclave for 1 1/2 hour. Cool and use 1 N acid-molybdate sol.

5. Reactive Silicate- blue colored complex with acidic molybdate. A reducing solution of metol and oxalic acid added to reduce the silicomolybdate complex and simultaneously decompose phosphate and arsenate interferences. (Strickland and Parson, 1972).

B. Physical

1. Conductivity- Hach Model 2510 (Battery Operated) Conductivity Meter in micromhos - 20°C.

2. pH-Corning pH Model 7 meter with a Bradley-James Combination Electrode

(continued)

3. Turbidity- Hach Model 2100 Turbidimeter in NTU units.

4. Temperature- Whitney Model TC-5A Thermistor or YSI Model 54 Thermistor (with the Dissolved O_2 probe).

5. Light-

   A. Whitney Underwater Light Meter with the following filters:

      RG2-red, OG2-yellow orange, VG9-green, BG12-blue, BG15-near ultra violet. Filters are Schott colored filters from Jenaer Glaswerk, Schott & Gen, Mainz.

   B. Secchi Disc- 20cm diameter.

Some reasonable degree of correlation between Secchi disc transparency and eutrophication can be found in natural lake situations. Rodhe (1965) demonstrated a relation of Secchi disc transparency, light extinction, and trophic status in a number of European lakes (Table 4.11). From this demonstration it was suggested by Allanson et al. (1973) that Monroe Reservoir had already reached a mildly eutrophic or mesotrophic level. It is known, however, on the basis of primary production, nutrient chemistry, and plankton data from this study, that Lake Monroe is not as well advanced as suspected. Light scattering by suspended non-biological particles decreases the Secchi disc transparency. We therefore propose that Lake Monroe is oligotrophic or, at most, mildly mesotrophic.

2. Temperature

A typical sequence of seasonal temperature profiles is shown by Docauer (Figure 4.4A) for 1972. Similar temperature curves were observed by Allanson et al. (1973) for the years 1971 and 1968. Stratification becomes apparent in late May to early June, reaching a maximum in late July to mid August. Isothermal conditions occur generally in late September-early October.

Partial turnovers or mixing do occasionally occur, especially after periods of cooler weather. Docauer (1972) indicates that at least two such events (August 8 and September 22) appeared in the Pine Grove Station (c). Likewise, Smith reported a similar mixing down to 6 meters in August 1971 at Station 1.

Table 4.10: Secchi Disc Transparency (Meters) in Monroe Reservoir Irrespective of Sampling Site, July-October 1968, 1971 and 1974.

			1968			
4.00	4.25	2.50	1.50	2.00	5.00	2.00
2.33	3.50	3.00	2.00	2.50	3.35	1.75
3.50	3.50	2.00				
Mean ($\bar{x}$)			2.85			
Std. Dev.			0.99			
n			17			
			1971			
4.10	2.10	3.05	2.00	4.35	3.50	3.25
3.60	4.25	1.70	5.10	2.40	3.55	2.00
1.60	3.75	2.95	3.70	2.70	2.30	3.55
2.20	3.50	4.00	2.00			
Mean ($\bar{x}$)			3.08			
Std. Dev.			0.94			
n			25			
			1974			
1.15	1.05	1.30	1.10	1.90	2.10	2.20
2.35	2.10	3.00	1.20	1.80	2.10	2.20
3.70	2.40	3.25	3.10	4.60	1.25	2.40
1.60	1.50	2.40	2.10	2.80	2.70	2.80
2.20	2.05	2.50	3.10			
Mean ($\bar{x}$)			2.28			
Std. Dev.			0.80			
n.			32			

Table 4.11:

A Comparison of Secchi Disc Transparency, Light Extinction, and Degree of Eutrophication in a Number of European Lakes.

E=Total Visible Energy

Productivity	Lake	Date	Depth in meters Secchi disc	E.1%
Very eutrophic	Lago di Varese	19.iv.57	2.3	6
	Erken	23.vii.57	2.4	8.5
Eutrophic	Gr. Plöner See	9.iv.57	5.3	7.0
	Zürichsee	1.v.57	4.5	8.5
	Bodensee	11.v.57	4.0	7.5
Oligotrophic	Torneträsk	16.vii.58	13.7	17
	Lago di Garda	25.iv.57	12.0	27

Data From Figure 2 in Rodhe (1965).

Both Stations 1 and 4 showed midsummer partial or complete mixing during 1974. Figures 4.4(B) and 4.4(C) indicate that maximum stratification in both basins occurred around the 17th of July. The unusually cool weather of late July and early August lowered the lake water temperature considerably. This caused the shallower, upper basin to mix completely before September 1. However, in the deeper, lower basin at Station 1, the thermocline was depressed to about 7 meters with partial mixing occurring in the upper waters. During the first week of September, this basin, likewise, completely mixed. This isothermal condition persists as demonstrated by the November 6 temperature profiles for both basins. Chemical uniformity also confirms this conclusion.

3. Specific Conductance

Conductivity is related to the concentration of ions present and therefore directly related to the alkalinity in lakes similar to Monroe, in which the dissolved electrolytes are chiefly calcium and magnesium bicarbonates. Table 4.12 shows the bottom water conductivity corrected to 20°C for the years 1968, 1971, and 1974. There is only a slight increase in the conductivity from 1971 to 1974 which may well be within the range of instrument error. Mean conductance was only slightly different in the surface and bottom samples, suggesting that density currents were not present during the sampling period. Also, the low uniform conductance may be a reflection of the early mixing of the basins, resulting in a lower standard deviation.

4. Alkalinity

The data for the three years (1968, 1971, and 1974) are presented in Table 4.13. The high values determined by Allanson (1971) must be questioned. There are two reasons for such a statement. First, conditions within the lake appear to be similar for the two years, in particular, the low summer and fall precipitation. Second, if Allanson's alkalinity readings are correct, then his conductivity values are about 100 micro-ohms too low. Data from Brummet's Creek, a tributary of North Fork, shows the following trend (Hartzell, unpublished):

A. 19 samples ranging from 60 to 78 ppm $CaCO_3$ have an average conductivity of 229.6 micro-ohms at 20°C.,

B. 11 samples ranging from 27 to 39 ppm $CaCO_3$ have an average conductivity of 136.5 micro-ohms at 20°C.

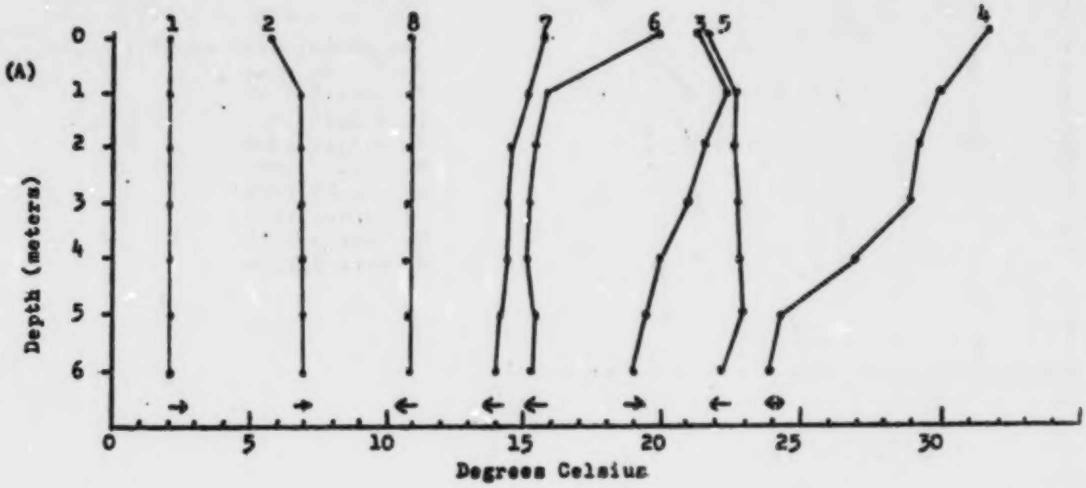
Similar trends are apparent from the major forks of Salt Creek.

Therefore, the alkalinity estimate by Allanson (1973) is highly questionable and probably should be similar to the 1974 mean value.

5. pH

The available data is given in Table 4.14. No significant difference in the mean surface or bottom pH values appears over

Figure 4.4:
Temperature Profiles from Pine Grove, Station 4, and Station 1.



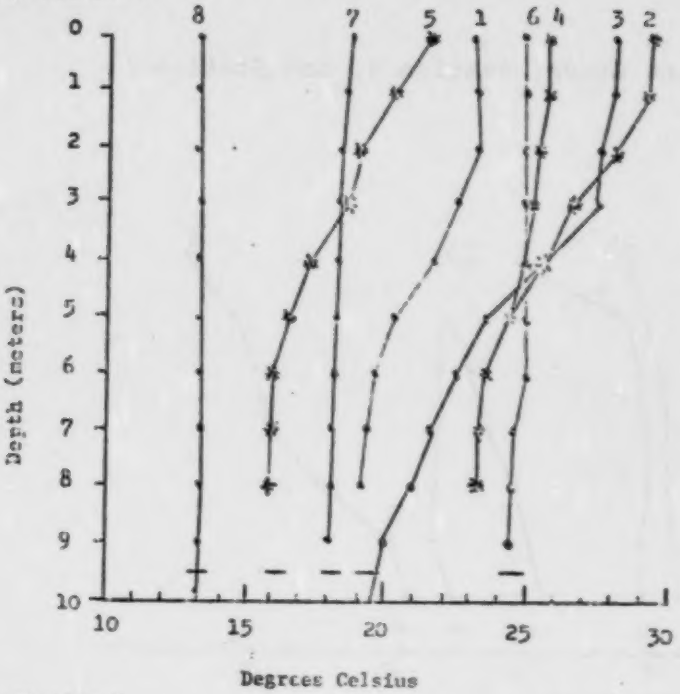
(A) Pine Grove temperature profiles 1972 by Docauer (1972).

Top numbers represent the following dates.

1. Feb.27,1972
2. Apr. 8,1972
3. May 30,1972
4. July25,1972
5. Sept22,1972
6. Oct. 6,1972
7. Oct.10,1972
8. Nov. 3,1972

Figure 4.4 (continued)

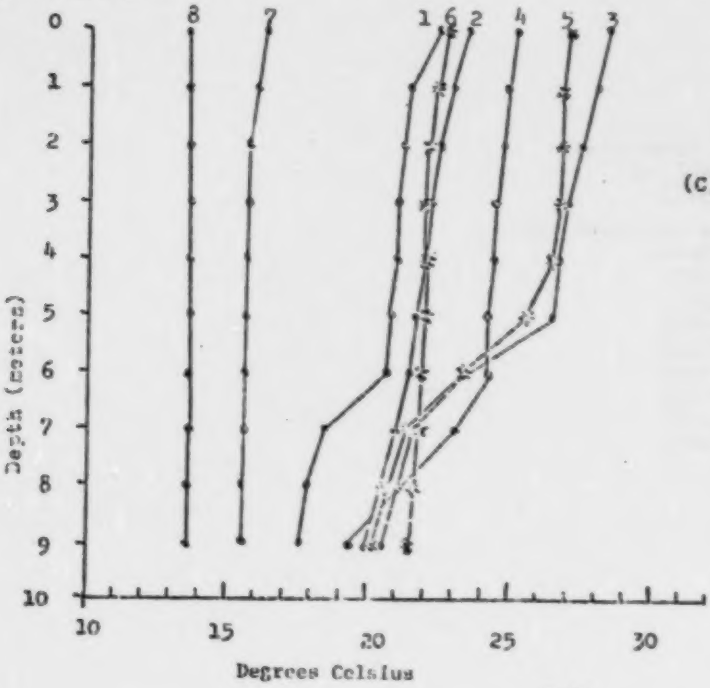
(B) Station 4



(B) Station 4 temperature profiles 1974 from June 7-Nov.7, 1974.

Top numbers represent the following dates.
1. June 7,1974
2. July10,1974
3. July17,1974
4. Aug. 2,1974
5. Aug.15,1974
6. Sept.1,1974
7. Sept28,1974
8. Nov. 7,1974

(C) Station 1



(C) Station 1 temperature profiles 1974 from June 2 to Nov. 7, 1974

Top numbers represent the following dates.
1. June 22, 1974
2. June 25, 1974
3. July 17, 1974
4. Aug. 8, 1974
5. Aug. 25, 1974
6. Sept. 7, 1974
7. Oct. 8, 1974
8. Nov. 7, 1974

three years. The maximum differences in pH occurred during stratification in mid-July. The early isothermal mixing of September accounts for the low deviation from the mean for 1974.

6. Phosphorus (Soluble Reactive Phosphate).

The extremely low levels of soluble reactive phosphate are shown in Table 4.15 and 4.16 Allanson (1973) estimated the surface concentration as 6 ug/l PO_4-P for the fall of 1971. Unfortunately, there is little data showing the effects of stratification and the usual phosphate trap system. However, the August 25 data at Station 1 does show a slight phosphate concentration increase on the bottom (Table 4.15). By September 7, the phosphate concentrations became uniform (small standard deviation) as a result of mixing.

A comparison of all stations (Table 4.16) shows that soluble reactive phosphate is slightly higher at Station 5 (the division between two major lake basins), and undetectable at Station 4. The effectiveness of the upper basin as a nutrient sink can vividly be observed from Tables 4.7 and 4.17. The average concentration for October at Station 6 (Kent Farm Road) was 7.6 ug/l PO_4-P. As this water moves down into the lake, its PO_4-P concentration is utilized by the macrophytes, bacteria, and algae. Water reaching the Pine Grove station (c) has, therefore, a concentration of 1-2 ug/l phosphate. Docauer (Table 4.5) shows a similar trend, although his values are higher. These findings

Table 4.12:
Comparisons of specific conductance (micromhos / cm) at 20 degrees Celsius of bottom water in Monroe Reservoir during July/August 1968*, September/October 1971** and August/October 1974.

	1968				1971		1974			
	88	112	72	98	120	112	142	134	123	129
	95	81	80	73	116	125	130	126	127	130
x	100	94	88	92	116	125	132	126	125	
	83	82	84	62	145	125	132	126	126	
Mean ($\bar{x}$)	86.5				123.0		129.1			
Std. dev.	12.2				10.2		4.9			
n	16				8		14			

*Zimmerman (1968)--** Allanson (1973).

Table 4.13:
Methyl Orange Alkalinity (as mg/l $CaCO_3$) Averaged values for surface and bottom waters in Monroe Reservoir during July/August 1968 (Zimmerman), September/October 1971 (Allanson) and August/October 1974.

	1968		1971		1974	
	Surface	Bottom	Surface	Bottom	Surface	Bottom
Mean (x)	37.5	42.5	72.8	77.6	33.32	34.64
Std. dev.	5.11	14.37	12.69	9.50	2.22	2.15
n	16	16	11	9	23	13

Table 4.14:
Comparisons of the Averaged pH of surface and bottom waters in Monroe Reservoir during July/August 1968 (Zimmerman), September/October 1971 (Allanson) and August/October 1974.

	1968		1971		1974	
	Surface	Bottom	Surface	Bottom	Surface	Bottom
Mean ($\bar{x}$)	7.8	7.2	7.7	7.4	7.7	7.5
Std. dev.	0.29	0.49	0.35	0.33	0.18	0.18
n	16	16	14	13	21	14

Table 4.15:

Chemical data showing the surface (0-meters), bottom (8-meters)and the mean ($\overline{x}$) and Std. Dev. Also included is the number of samples analysed in the vertical water column.

Station	Date	Depth meters	Nitrite	Nitrate	Ammonia	Sol. React. Phosphate	Total Phosphate	Silicates
#1	Aug-25	0	0.5	2.0	6.3	0.7	8.5	2360
		8	2.0	16.0	64.3	4.0	15.8	3146
X±std. dev. (N=5)			0.8 ±.67	4.5±6.4	16.4±26.8	1.4±1.5	10.2±3.2	2561±331
	Sept-07	0	2.0	7.5	52.7	0.4	7.0	2659
		8	2.0	6.5	62.7	0.6	6.5	2556
X±std. dev. (N=5)			2.0±0.0	6.3±0.7	57.3±4.5	0.7±0.3	6.8±0.4	2612±57
	Nov-06	0	3.2	37.5	20.3	1.0	13.0	1978
		8	3.2	39.0	21.5	1.0	12.2	2016
X±std. dev. (N=3) (Lower Basin)			3.2±0.1	37.1±1.3	21.3±1.2	1.0±0.0	12.6±0.6	1999±19
#5	Sept-16	0	0.3	7.2	3.1	1.4	16.8	1803
		8	0.3	7.2	14.4	2.2	13.8	1916
X±std. dev. (N=3)			0.3±0.0	7.0±0.4	8.3±5.7	1.7±0.5	15.2±1.5	1863±57
	Nov-06	0	1.1	12.5	15.9	1.0	12.1	1356
		8	1.1	12.0	14.9	1.0	13.0	1344
X±std. dev. (N=3) (Division: Lower and Middle)			1.1±0.1	12.2±0.3	13.8±2.9	1.1±0.2	13.2±1.2	1346±10
#4	Sept-01	0	1.3	4.8	26.2	2.5	12.7	1100
		8	2.0	6.2	42.1	3.3	17.0	1135
X±std. dev. (N=4)			1.3±0.5	5.1±0.8	26.9±10.9	2.3±0.7	16.0±2.9	1121±27
	Nov-06	0	1.5	18.3	26.4	1.7	17.7	624
		8	1.5	18.3	24.8	1.8	16.3	626
X±std. dev. (N=3) (Upper basin)			1.5±0.1	18.4±0.2	24.3±2.4	1.7±0.1	17.2±0.8	629±06

Table 4.16:
Chemical data showing surface chemistry for stations #1, 3, 4 and 5 on September 07, 1974.**

Station	Date	Depth meters	Nitrite	Nitrate	Ammonia	Sol. React. Phosphate	Total Phosphate	Reactive Silicate
#1 (Lower Basin)	Sept-07	0	2.0	7.5	52.7	0.4	7.0	2659
#5 (Division: Lower & Middle)	Sept-07	0	1.5	4.5	9.5	2.0	7.5	1943
#3 (Middle Basin)	Sept-07	0	1.1	3.4	7.9	0.6	8.7	1704
#4 (Upper Basin)	Sept-07	0	1.5	3.5	3.9	0.0	7.7	783

**concentrations in micrograms per liter (ppb).

Table 4.17:
Chemical data of the upper basin of Monroe Reservoir taken on September 1 and October 8, 1974 from the surface (0-meters). All concentrations are in micrograms per liter or ppb.

Station	Date	Nitrite	Nitrate	Ammonia	Sol. React. Phosphate	Total Phosphate	Reactive Silicatc
Pine Grove (c)	Sept-01	1.0	2.5	7.6	1.8	21.7	335
	Oct-08	1.5	4.3	7.3	1.0	21.1	---
South and Middle forks Only	Sept-01	1.2	5.2	18.4	1.4	20.0	861
	Oct-08	1.3	2.1	14.7	0.4	20.5	---
All Forks Combined	Sept-01	0.9	2.0	23.5	1.5	12.8	1025
	Oct-08	1.0	1.3	9.3	0.3	18.8	----
Causeway #4	Sept-01	1.3	4.8	26.2	2.5	12.7	1100
	Oct-08	1.3	1.3	8.1	0.3	17.1	----

simply stress the importance of the upper basins of this lake as phosphate regulators. This is generally attributed to the extensive macrophyte beds and their associated epiphytic algae along with the greater diatom populations in this basin (Allanson et al., 1973).

7. Phosphorus (Total Hydrolysable Phosphate).

Total phosphate tends to follow rather closely the general scheme for soluble reactive phosphate. During stratification, the greatest concentration is found near the bottom but as mixing occurs the concentration is uniform in the vertical water column. Table 4.16 shows that all stations had similar surface concentrations on September 7. There is a tendency for an increase in total phosphates as the fall progresses, perhaps indicating an increased algal biomass. This same trend can be traced in the upper basin. The higher soluble reactive phosphate levels are closely paralleled with higher total phosphate (greater algal biomass) and as the soluble reactive phosphate declines, so does the total PO_4.

8. Nitrogen

The forms of nitrogen present in lake waters may be grouped as:

(1) molecular nitrogen (N_2) in solution;

(2) organic nitrogen compounds, including decomposition products (ranging from proteins to simple compounds like amino acids and urea);

(3) ammonia (NH_4^+ and NH_4OH);

(4) nitrite (NO_2^-);

(5) nitrate (NO_3^-).

The combined nitrogen of lakes is probably derived mainly from inflowing water (Hutchinson, 1956). However, recent evidence shows that precipitation can carry considerable quantities of nitrogen into a lake (Likens and Bormann, 1974).

9. Nitrogen (Nitrite).

Nitrites are intermediates in the oxidation or reduction processes of bacteria. The low concentration of this nutrient throughout the current investigation suggests that this form of nitrogen plays a very minor part in the nitrogen dynamics of Lake Monroe. A more typical year with a longer stratification period might have yielded a different conclusion.

10. Nitrogen (Nitrate).

The extremely low concentrations of nitrate-N found throughout the reservoir is surprising when one views the stream data for Station 6 on North Fork and those on Middle and South Forks of Salt Creek (Tables 4.7 and 4.17). The efficiency of the macrophytes, etc. in removing this nutrient is obvious. These extremely low readings do not coincide with Allanson's mean value of 124 ug/l NO_3-N for 1971. Only when the water begins to cool and light decreases does one see an appreciable increase in nitrate concentration (Station 1 on Nov. 6).

11. Nitrogen (Ammonia).

Ammonia is produced by practically all heterotrophic bacteria in the course of organic decomposition. This explains the large accumulation of ammonia during stratification on the bottom of the lake, as seen at Station 1 (Table 4.15). The ammonia also became uniformly distributed during the fall mixing. Large amounts can leave the system at this time and may explain the decrease in ammonia concentrations during October. However, several algae are capable of utilizing this nutrient as well (Hutchinson, 1957). When one looks at the surface concentration across the lake (Table 4.16), there is no apparent trend to the varying concentrations.

12. Silicate

Silica is the most abundant acidic substance other than bicarbonates in lakes, and is of immense significance as a major nutrient for diatoms. At the pH values of natural water, Silica occurs mainly as ortho silicate (reactive) in an undissociated condition (Hutchinson 1957).

The distribution of silicate throughout the lake is puzzling. The data indicate that the high concentrations at Station 6 and the Middle and South Forks (Table 4.17) are effectively removed as the water moves down through these upper basins. However, the gradual increase of reactive silicates from Station 4 to 1 (Table 4.16) is difficult to explain. On November 6, sampling again showed the greater concentration of silicate at Station 1.

The apparent difference in silicates throughout the basins has two possible explanations: (1) the respective diatom populations of the basins may vary considerably, with the lower basin having the least diatoms; or (2) this difference may depend upon the morphometric slope and depth of the respective basins. This problem needs more investigation, specifically because the relation of phytoplankton distribution and abundance to the silicate concentration is not clear.

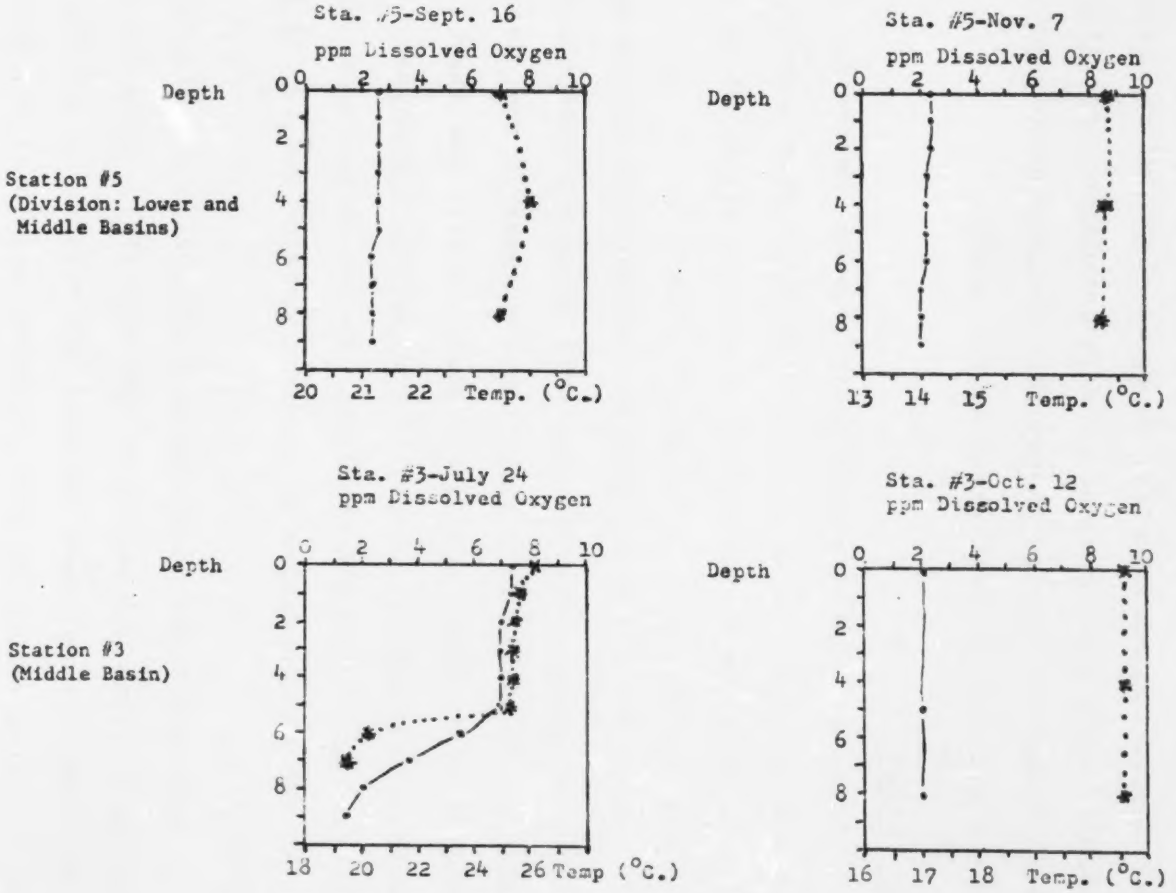
13. Oxygen

There is a close relationship between the thermal regime and the distribution of dissolved oxygen. This thermal regime affects both the concentration of the gas dissolved in the water and its distribution in the water column.

Figures 4.5 and 4.6 compare the temporal distribution of oxygen at these stations. One must agree with the statement of Allanson et al. (1973), that "rapid changes in the distribution of dissolved oxygen are linked directly with the thermal regime." During the midsummer mixing of the basins, the oxygen is evenly distributed in the water column. As the water cools during the fall, the concentration of oxygen increases due to its increased solubility.

Allanson found no significant change in the dissolved oxygen content between the period of 1968 and 1971. Only in the deeper Salt Creek channel does one find any serious oxygen depletion. The relative volume of this old creek bed is minor, though, in comparison to the basins. The 1974 oxygen concentrations agree with the findings of Allanson et al. (1973).

Figure 4.5:
Oxygen and Temperature profiles from Stations 5 and 3. (Dotted lines = 0_2 conc., dash line = Temp.)



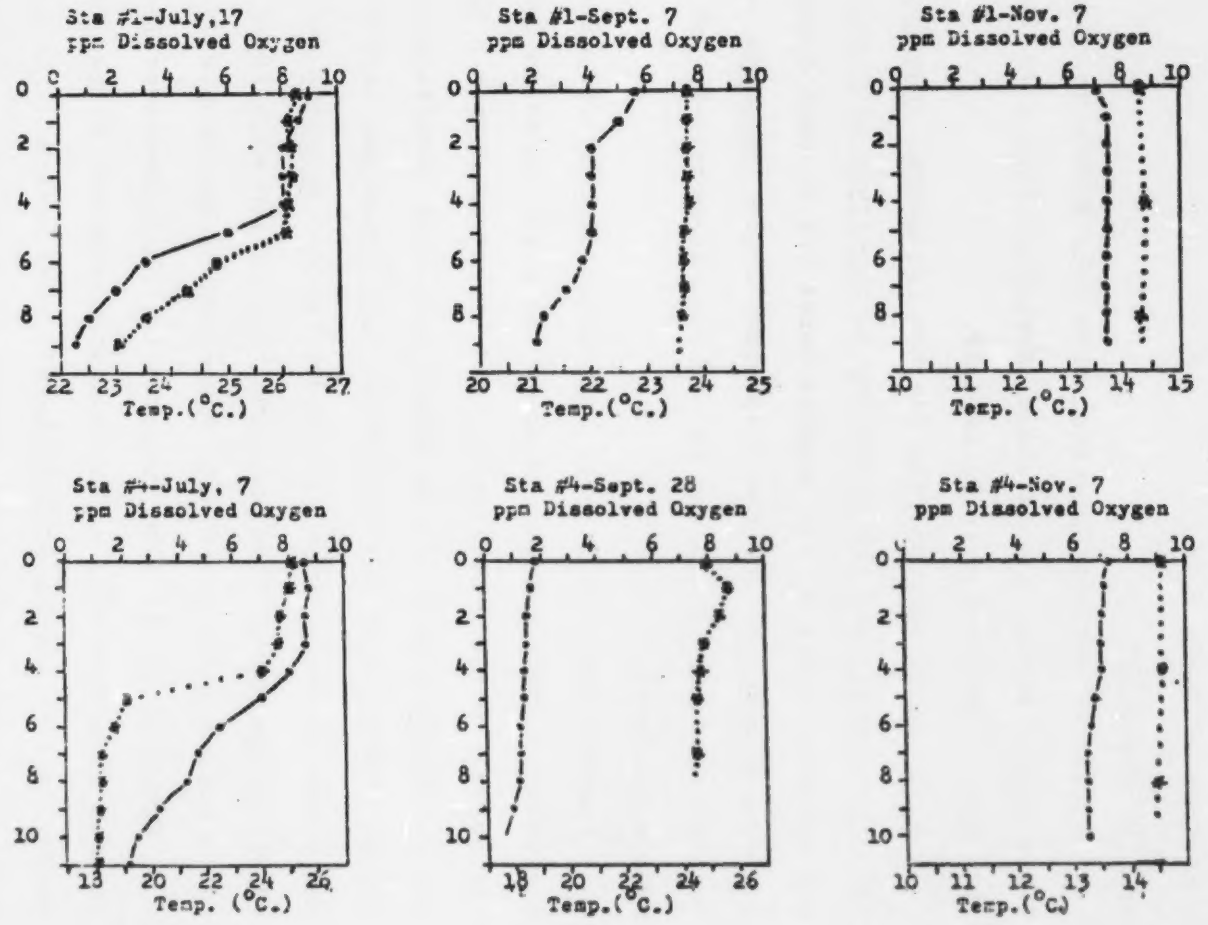
Sta. #5-Sept. 16

Sta. #5-Nov. 7

Sta. #3-July 24

Sta. #3-Oct. 12

Figure 4.6:
Oxygen and Temperature profiles from stations 1 (Lower Basin) and 4 (Upper Basin). (Dotted lines = oxygen conc. dashed = Temp.)



D. ORGANISMS

Methods of biological assessment of the lake waters are described in Table 4.18.

1. Phytoplankton

A list of net phytoplankton from Lake Monroe is given in Table 4.19. Nannoplankton algae identified from a 19 October 1974 sample are listed in Table 4.20.

With few exceptions, the diatoms, *Melosira*, *Fragilaria*, and *Asterionella* and the chrysophyte, *Dinobryon divergens* were the dominant forms on all sampled dates and at each depth. Diatoms, *Dinobryon*, and the blue-green algae, *Anabaena*, were most abundant in 57, 38 and 10 percent, respectively, of the samples counted.

Correlation coefficients were calculated by Schaefer (1974) for relationships between selected algae and three environmental variables: light, temperature, and dissolved oxygen. *Melosira* and *Dinobryon* showed little correlation with temperature and oxygen. *Fragilaria* was correlated with dissolved oxygen and had low negative correlation with light (as did *Melosira* and *Dinobryon*). *Asterionella* showed high positive correlation with light ($r=0.5139$) and negative correlation with dissolved oxygen ($r=0.6177$).

Schaefer (1974) also computed the Shannon-Weaver index of general diversity ($\bar{H}$), which indicated that one or two forms were predominant in the upper lake levels (0-3 meters). At greater depths, increased diversity was found. The index ranged from 0.0473 to 0.9050, indicating that the composition and abundance of plankton populations were highly variable and not static. Well stratified algal populations existed in areas not circulated by wind action (e.g., Station 4), and during calm periods (Station 3).

Large-scale differences were apparent when plankton populations from the three basins were compared. (Tables 4.21, 4.22, and 4.23). For example, the middle basin may contain more plankton organisms per liter than the upper basin or much less than the upper basin. It may become essential in further work to regard the reservoir as three separate, functional units, since dramatic chemical plankton changes occur in moving from the upper basin to the middle basin, and again to the lower basin.

Both the large number of phytoplankton genera present and the prevalance of diatoms and Dinobryon suggest a low electrolyte situation. Nutrient loadings above current levels would serve to bring about the dominance of fewer algae and a decrease in community diversity and stability. Blue-green algae would probably show the largest increases since they are capable of fixing atmospheric nitrogen, and are not retarded by low concentrations of dissolved nitrogen that occur in summer and early fall (see Table 4.15). One of those blue-green algae, Anabaena is presently dominant in 10% of the sample.

Seasonal changes in phytoplankton population density were measured by pigment estimation, which has been found to be a good indicator of nutrient conditions and an accurate estimator of population density and primary production (Brylinsky

Table 4:18
Methods of Biological Assessment

1. **Phytoplankton:**

Sampled with Kemmerer sampler operated at various depths and preserved with Lugol's solution.

Qualitative sampling with vertical hauls of a Wisconsin standard plankton net.

One ml aliquots of concentrated samples were placed in a Sedgwick-Rafter cell and enumerated under 100X magnification with a Leitz Wetzlar Ortholux microscope.

Nannoplankton were observed with a Nikon inverted phase microscope.

$$\text{Phytoplankton/l} = \frac{\text{cell count X } 1000\text{mm}^3}{50\text{mm}(1.74\text{mm})(1\text{mm})(2)} \times \frac{125 \text{ ml}}{\text{V (ml)}} \times 1000$$

where: 1000mm^3 = volume of Sedgwick-Rafter cell
50mm = length of Sedgwick-Rafter cell
1.74mm = width of strip counted
1mm = height of Sedgwick-Rafter cell
2 = number of strips counted
V = sampled volume of water in mls.
125ml = concentrated volume of sample

a) Chlorophyll determination

Pigment estimations were determined by the Strickland and Parson (1972) technique of dissolving 0.34 u Millipore filter paper following filtration in 10 ml of 90% acetone solvents for about 20 hours in the dark, then stirring and centrifugation. The top supernatant liquid was decanted into a 1 cm cell. Readings were made on a Beckman DU-2 spectrophotometer at 665, 645 and 630 mu. Triplicate determinations were made at each depth and samples were taken from each meter 0 - 8. The results were then calculated, using the equations formulated by Strickland and Parsons (1972):

$$\text{Chl a} = 11.6\ E665 - 1.31\ E645 - 0.14\ E630$$

$$\text{Chl b} = 20.7\ E645 - 4.34\ E665 - 4.42\ E630$$

$$\text{Chl c} = 55\ E630 - 4.64\ E665 - 16.3\ E645$$

continued. . .

b) Algal Bioassay Tests

Method I

The March 6-10, 1973 experiment was made, using water taken from the surface at the causeway with additions of three different levels of phosphate (PO_4-P) 5, 15, and 50 ug/l and of three different levels of nitrate (NO_3-N) 75, 225, and 750 ug/l, which were added into 300 ml B.O.D. bottle in 250 ml of water. Seven different concentrations of samples and one opaque control sample, were inoculated with 1 ml of $Na_{14}CO_3$, and placed into an environmental chamber on a shaker set of 100 rpm under 450 ± 20 foot-candle illumination for 4 continuous day's incubation.

At 6 hours, 25 hours, 48 hours, 72 hours, and 96 hours, after incubation, 50 ml of sample was removed from the bottle and filtered through 0.45 μ Millipore membranes at a vacuum of 0.25 atmospheres. The filters were placed onto an aluminum planchett for desiccation, then exposed to HCl fumes for 10 minutes to remove inorganic C^{14}. The filters were counted on a Geiger-Müller counter.

Method II

The October 1-3, 1974 experiment was conducted, using the standard algal assay procedure (EPA, August 1971). The water sample was taken from the surface at Station 3 with two different concentrations of phosphate (PO_4-P), 5 ug/l and 25 ug/l, and two different concentrations of nitrate (NO_3-N), 25 ug/l and 125 ug/l, added into a 2 gallon jar with 2 liters of lake water. This constituted 8 different levels of concentration. There were: 1) Control (pure lake water), 2) Control plus 5 ug/l phosphate, 3) Control plus 25 ug/l phosphate, 4) Control plus 25 ug/l nitrate, 5) Control plus 125 ug/l nitrate, 6) Control plus 5 ug/l phosphate and 25 ug/l nitrate, 7) Control plus 5 ug/l phosphate and 125 ug/l nitrate, and 8) Control plus 25 ug/l phosphate and 125 ug/l nitrate. Then the 8 jars with different concentrations of nitrogen and phosphorous were placed into an environmental chamber with previously described conditions. After an initial measurement, every 24 hrs. 50 ml of sample were removed from each bottle. Triplicate measurements of each concentration were made. Each sample was filtered through 0.45 μ Millipore Membrane at a vacuum of 0.25 atmosphere and washed with distilled water to remove inorganic C^{14}. The filters were counted using an LS 100 Scintilliation Counter. The counts after corrections were coverted to obtain relative rates of growth to the control.

continued . . .

Table 4.18 (continued)

2. Zooplankton:

Sampled with a metered Clarke-Bumpus trawl equipped with a no. 18 wire mesh bucket. Integrated vertical hauls as well as horizontal tows were taken at depths of 0, 3, 6 and 9 meters. Samples were concentrated to a volume of 125 ml and entire 1 ml sub-samples were counted on a Sedgwick-Rafter cell at 40X using a Leitz Wetzlar microscope.

$$\text{Zooplankton/m}^3 = \frac{\text{Total volume of concentrated sample (ml)} \times \text{zooplankton/ml of conc. sample}}{\text{volume of water sampled (liters)}} \times \frac{1000\ \text{liter}}{\text{m}^3}$$

Table 4.19:
Phytoplankton Organisms Identified from Lake Monroe,
June-August 1974.

1. Cyanophyceae
    - Chroococcales
        - Chroococcus
        - *Coelospaerium
        - Dactylococcopsis
        - Gloeocapsa
        - Gomphosphaeria
        - Marssoniella
        - Merismopedia
        - Microcystis
    - Chaemaesiphonales
        - Pleurocapsa
    - Oscillatoriales
        - *Anabaena
        - Lyngbya
        - Oscillatoria
2. Chlorophyceae
    - Chlorococcales
        - Ankistrodesmus
        - Crucigenia
        - Lauterborniella
        - Oocystis
        - Pediastrum
        - Scenedesmus
        - Tetraëdron
    - Tetrasporales
        - Gloeocystis
    - Volvocales
        - Volvox
    - Zygnematales
        - Closterium
        - Cosmarium
        - Gonatozygon
        - Micrasterias
        - Spirogyra
        - Staurastrum
3. Chrysophyceae
    - *Dinobryon
    - Mallomonas
    - Ochromonas
4. Xanthophyceae
    - Asterogloea
    - Ophiocytium
5. Bacillariophyceae
    - Centrales
        - Cyclotella
        - *Melosira
        - Stephanodiscus
        - Terpisnoe
    - Pennales
        - Amphiprora
        - Amphora
        - *Asterionella
        - Cymbella
        - *Fragilaria
        - Gyrosigma
        - Navicula
        - Neidium
        - Nitzschia
        - Surirella
        - Synedra
        - Tabellaria

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*most commonly encountered phytoplankters.

Table 4.20:
Nannoplankton Algae and Protozoa. Identified from a 19 October 1974 Lake Monroe sample at Station 4 (Upper Basin).

■ Melosira italica
■ Melosira sp.

■ Dinobryon divergens
■ Dinobryon bavaricum

■ Stephanodiscus sp.

■ Merismopedia tenuissima
■ Merismopedia minor

■ Ankistrodesmus sp.

■ Cryptomonas sp.

■ Fragilaria crotonensis

■ Chroococcus limneticus
■ Chroococcus minor

■ Mallomonas akrokomas
■ Mallomonas sp.

■ Coelastrum sp.

■ Asterionella formosa

■ Anabaena lemmermanni

■ Coelosphaerium kutzingianum

■ Stombidium viride

Table 4.21:
Phytoplankton organisms per liter from integrated vertical samples, 15 June 1974.

	(Middle Basin) station 3		(Upper Basin) station 4	
	$\overline{X}/\ell$	σ	$\overline{X}/\ell$	σ
Dinobryon	1562	76	1035	0
Asterionella	4778	560	3506	490
Fragilaria	233	76	230	81
Melosira	144	51	374	122
Neidium	18	25	-	-
Ceratium	539	102	201	41
Chrysophyceae	18	25	29	41
Pediastrum	18	25	-	-
Gomphosphaeria	18	25	29	41
small Chlorococcales	162	25	58	81
peritrichs	18	25	-	-
Pleurosigma	-	-	29	41
Totals	7508	559	5518	410
% Dinobryon	20.8		18.8	
% diatoms	68.9		75.0	
% blue-green algae	0.2		0.5	

Table 4.22:
Phytoplankton organisms per liter
From integrated vertical samples
28 June 1974

	(Lower Basin station 1		(Middle Basin) station 3		(Upper Basin) station 4	
	$\overline{X}/\ell$	σ	$\overline{X}/\ell$	σ	$\overline{X}/\ell$	σ
Fragilaria	483	166	599	373	86	122
Synedra	39	18	240	0	86	41
Melosira	39	18	1030	34	115	163
Asterionella	248	18	814	68	86	122
Dinobryon	575	111	264	373	1610	410
small chlorococcales	91	18	96	68	-	-
Microcystis	39	18	-	-	-	-
Anabaena	1280	333	24	34	230	163
peritrichs	52	37	-	-	345	0
Ceratium	157	74	383	136	316	203
Staurastrum	52	37	240	0	-	-
Gomphosphaeria	13	18	-	-	-	-
Crucigenial	-	-	24	34	-	-
Stephanodiscus	-	-	96	0	-	-
Navicula	-	-	96	68	-	-
Gloeocapsa	-	-	24	34	-	-
Pleurosigna	-	-	24	34	-	-
Ankistrodesmus	-	-	24	34	-	-
Surirella	-	-	24	34	-	-
Chrysophyceae	-	-	-	-	28	41
Totals	2835	794	3760	305	2902	41
% Dinobryon	20.3		7.0		55.5	
% diatoms	28.5		77.7		12.8	
% blue-green algae	45.6		1.3		7.9	

Table 4.23:
Phytoplankton organisms per liter
from integrated vertical samples
5 July 1974

	(Lower Basin) station 1		(Middle Basin) station 3		(Upper Basin) station 4	
	$\overline{X}/\ell$	σ	$\overline{X}/\ell$	σ	$\overline{X}/\ell$	σ
Tabellaria	594	-	-	-	-	-
Asterionella	441	-	166	16	205	58
Nitzschia	19	-	-	-	-	-
Navicula	399	-	11	16	-	-
Cymbella	19	-	-	-	-	-
small Chlorococcales	38	-	-	-	20	29
Ceratium	57	-	33	16	123	116
Synedra	38	-	-	-	82	116
Fragilaria	1974	-	796	156	328	58
peritrichs	307	-	387	47	801	87
Chrysophyceae	38	-	11	16	-	-
Gloeocapsa	57	-	44	31	20	29
Microcystis	57	-	11	16	20	29
Amphora	19	-	-	-	-	-
Dinobryon	192	-	1360	109	7944	784
Melosira	651	-	-	-	862	58
Stephenodiscus	498	-	-	-	-	-
Anabaona	2050	-	2708	109	1663	261
Stauastrum	77	-	44	0	28	29
Synedra	-	-	44	31	-	-
Crucigenia	-	-	11	16	82	116
Totals	7530	-	6157	234	12340	1393
%Dinobryon	2.5		22.1		64.4	
% diatoms	61.3		16.5		11.3	
% blue-green algae	28.7		44.9		13.8	

and Mann, 1973). The correlation of estimation between phytoplankton chlorophyll a and biomass, as indicated by Brylinsky and Mann, was 0.98. This value indicates that it estimated chlorophyll a almost as well as phytoplankton populations. The correlation between photosynthetic efficiency and chlorophyll a was 0.92. All these suggest that pigment estimation constitutes a good means of estimating primary production and population density (Brylinsky and Mann, 1973).

Pigment estimations were made from August to October (Figure 4.7). The highest total chlorophyll reading was found in the beginning of August. The lowest measurement was taken in the middle of September. Maximum difference, excluding the month of August, was less than 8mg/m^3, which was insigificant compared to the variance of any single measurement (Figure 4.8). The exceedingly high variance shown in the month of August was probably due to strong patchiness of aggregated phytoplankton biomass at certain depths in the water column. Maximum chlorophyll content was frequently found from 0-3 meters in depth. Little vertical difference was obtained after August's measurements, indicating circulation in the lake.

An increase in population density is generally associated with increases in light extinction as measured by the minimum extinction coefficient. However, no strong correlation was found between them in Monroe Reservoir. Poor correlation is likely due to the contribution to varying quantities of organic and inorganic detritus and dissolved colored matter (Bindloss et al., 1972). It may also be influenced by changes in species composition of the phytoplankton.

No significant relation was found between population density and nitrogen concentrations, but a negative correlation was seen with soluble reactive phosphorus and also with reactive silicate (Figure 4.9 and 4.10). This appeared to be an inverse relation to what Brylinsky and Mann found. If, however, total phosphorus was plotted against population density, a strong positive correlation would result. Brylinsky and Mann found the following correlations between chlorophyll a and mean nutrient concentrations: soluble reactive phosphorus, +0.78; nitrate, +0.59; and total nitrogen, +0.49. Exactly the opposite correlation found here may be due to the rapid consumption of dissolved phosphorus and reactive silicate by phytoplankton populations in Lake Monroe. This suggests that a great increase of aquatic macrophytes competing for available nutrients would essentially control phytoplankton blooms in the upper basin. Similarly, if the weeds were removed, increases in phytoplankton would result.

Two separate algal assay tests were conducted during March 6-10, 1973, and October 1-3, 1974. The techniques applied to the two experiments were somewhat different, and are stated separately in Table 4.18. The readings for the first method were corrected and plotted in Figure 4.11; results of Method II are shown in Figure 4.12.

The two bioassay experiments show similar results. The addition of phosphate (PO -P) stimulates a rapid rate of growth.

Prolonging the time of incubation stimulates a much higher growth rate. The addition of nitrate, after an initial increase, produces no significant increase in growth rate (Figure 4.12). The addition of phosphate and nitrate shows a continuous increase in rates of production with longer incubation periods. It is shown that the rate of growth of combined nutrients has a 1.7 times higher rate than the control (Figure 4.12).

To summarize the data, the increase of phosphate content is of great importance in the growth of algae in Monroe Reservoir. Limiting the phosphate (PO_4-P) input to the reservoir is the best method of controlling algal blooms.

2. Zooplankton

In the fall of 1971, the zooplankton population was dominated by a calanoid, a cyclopoid, their copepodites and nauplii. Rotifers, especially *Keratella*, were abundant. *Daphnia laevis* and *Daphnia retrocurva* were both present, although less important. *Ceratium* was locally abundant (Allanson et al., 1973). Allanson et al. also concluded that a pelagic community of zooplankton is present in Lake Monroe, even though the reservoir is fairly shallow.

Table 4.24 lists zooplankton observed from June to August, 1974. Tables 4.25 and 4.26 show variations in integrated vertical samples between stations. Table 4.27 gives populations at discrete levels.

Codonella, a vase-shaped ciliate, showed wild population fluctuations, varying between 0 and 60,000 organisms/m^3 in

Figure 4.7:
Phytoplankton population density as mg. Chlorophyll per m^3 vs. depth and temperature.

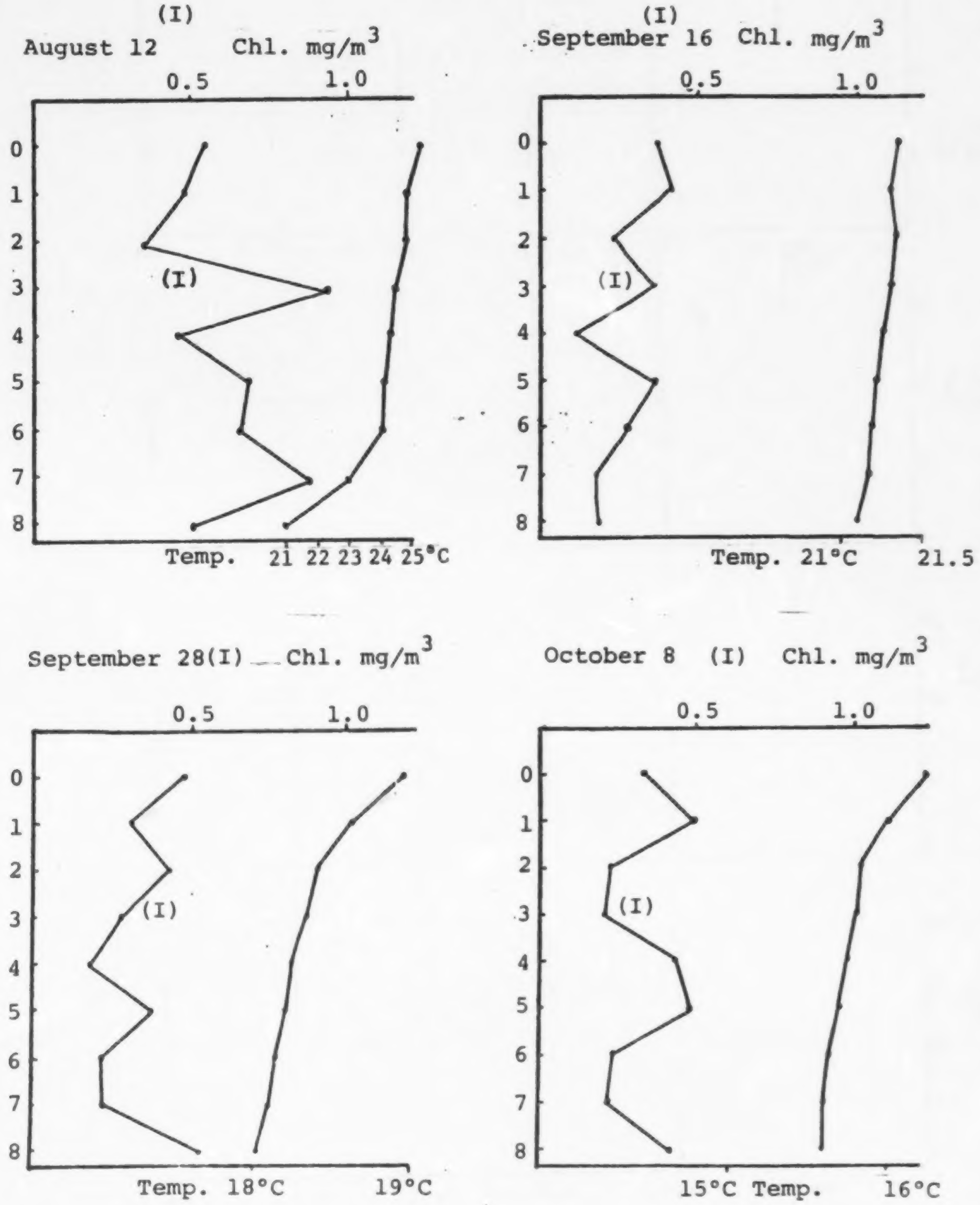


Figure 4.8:
Variations in population density shown as mg. Chlorophyll per m^3 $(n = 9)$

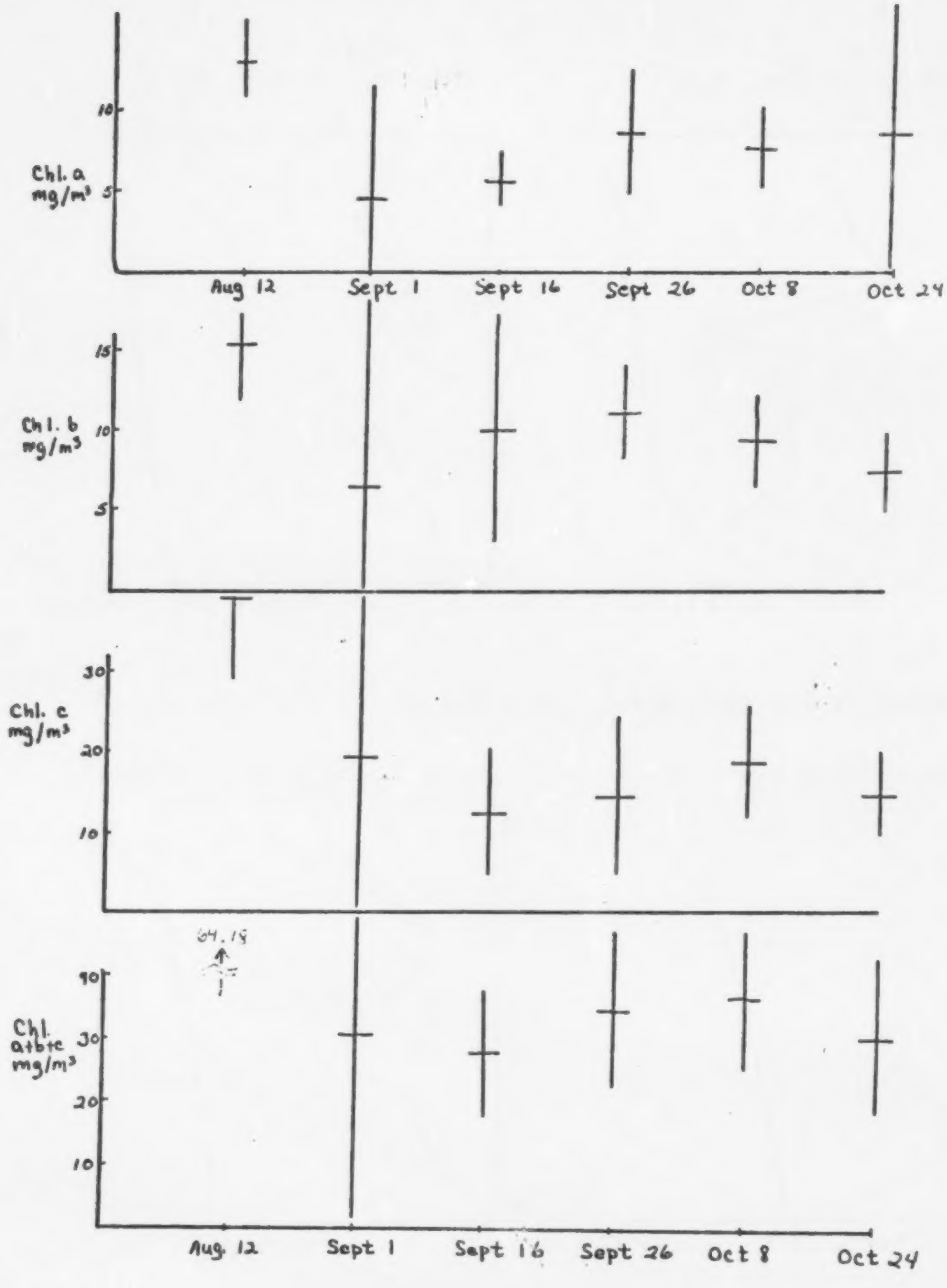


Figure 4.9:

Regression between Total Chlorophyll and PO_4-P (soluble reactive phosphorus).

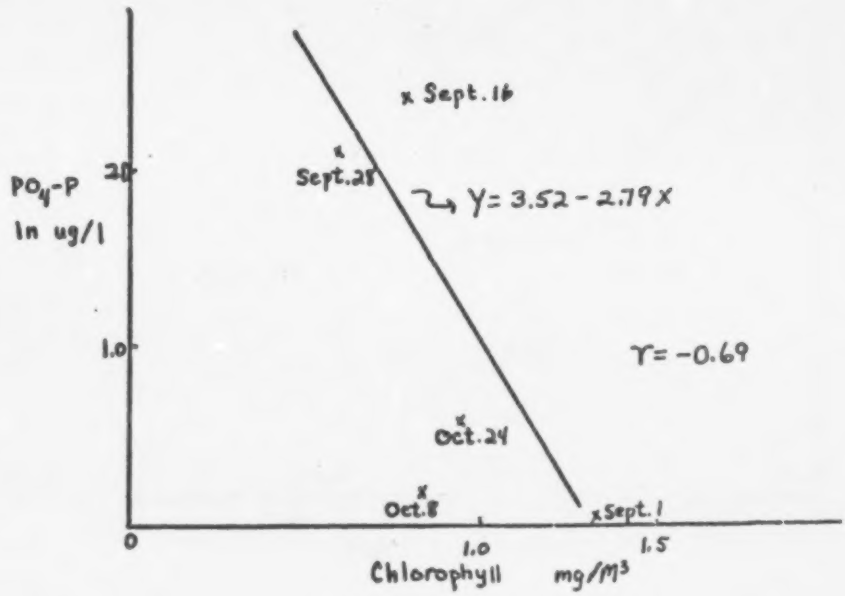


Figure 4.10:

Regression between Total Chlorophyll and reactive Silicate.

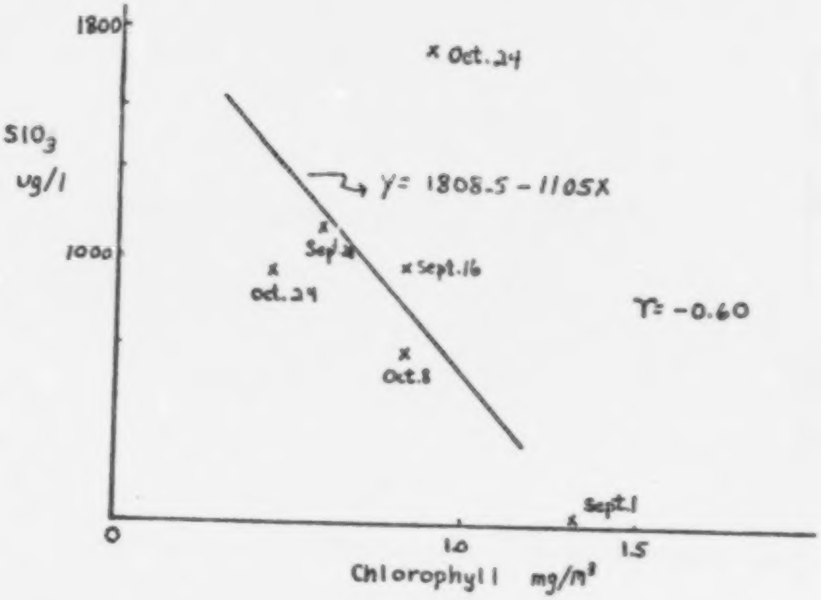


Figure 4.11:

Algal bioassay incubation test, March 6, 1972.

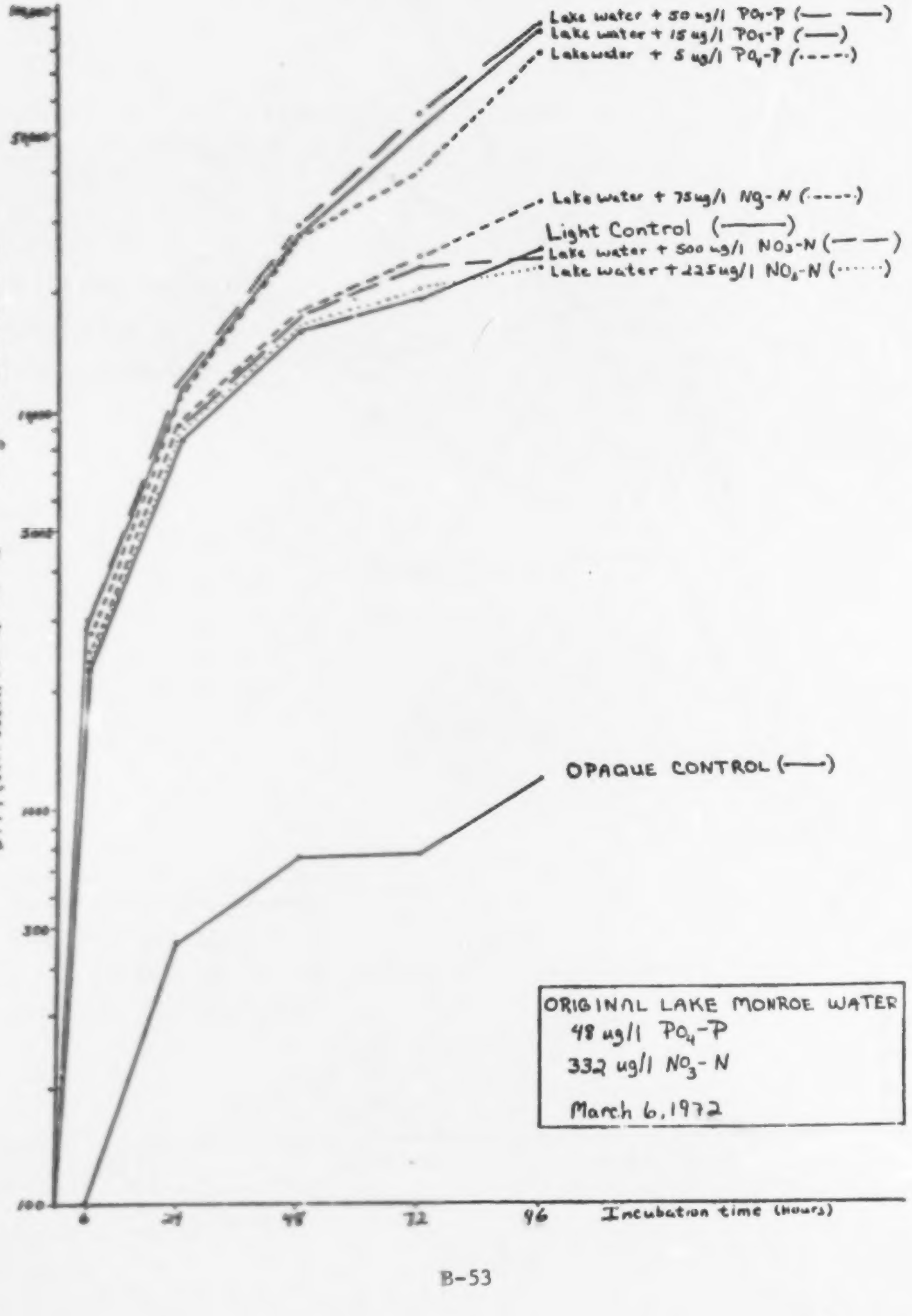
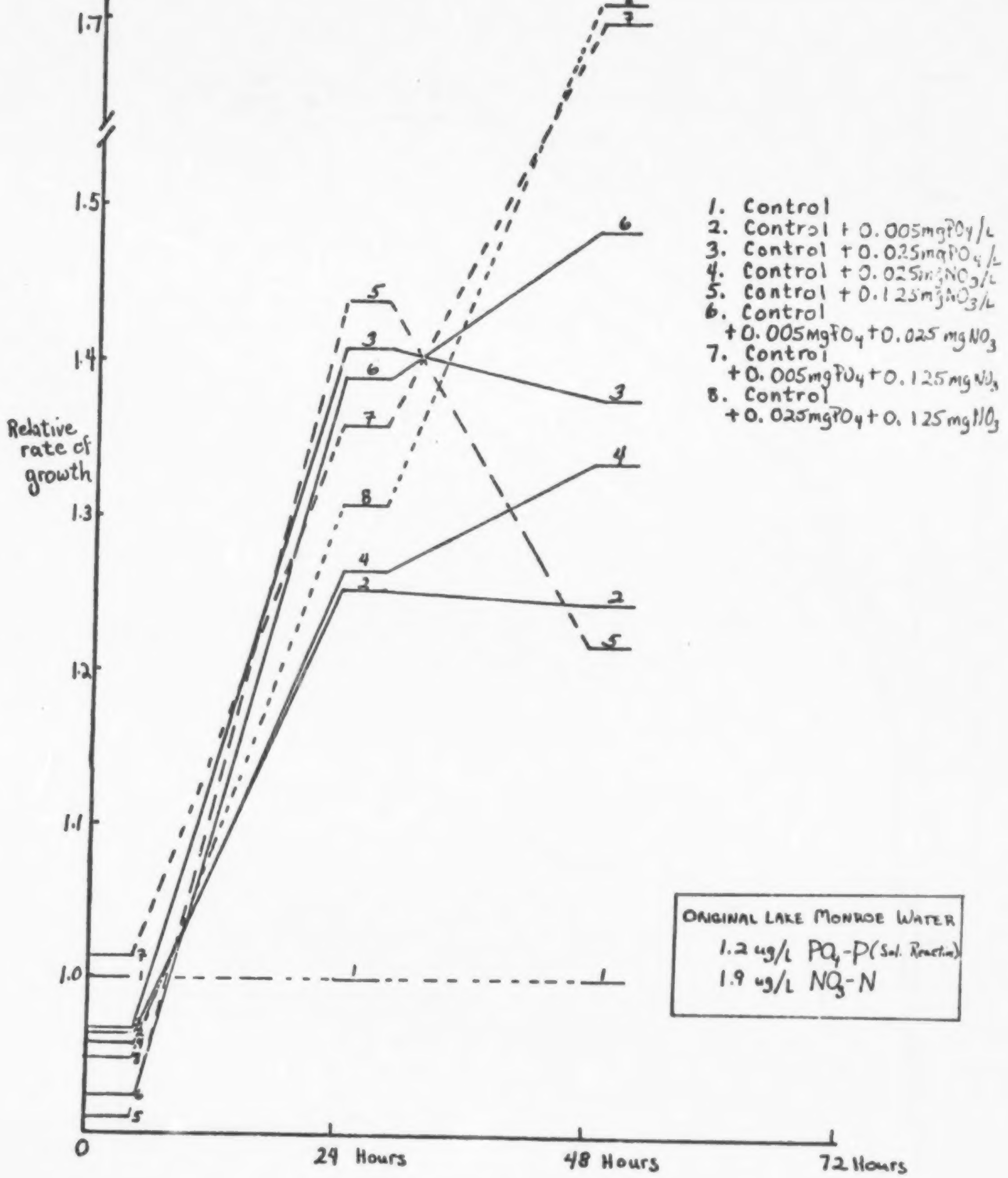


Figure 4.12:

Algal assay with different additions of nutrients.



one month. The dinoflagellate *Ceratium*, as well, showed great variation in population size.

A very diverse assemblage of rotifers was found (12 genera). Of these, *Keratella cochlearis* and *Polyarthra vulgaris* were most common.

One calanoid and two cyclopoid copepods were found. Their larval stage, the nauplius, was quite abundant throughout June and July.

Bosmina coregoni was the most abundant Cladoceran, reaching a density of 140,000/m^3 on 24 June 1974 at a depth of 3m at station 4. It declined logarithmically after this peak.

Two species of *Daphnia* were encountered, *retrocurva* and *laevis*. *D. retrocurva* was much more abundant and also showed pronounced helmet development (cyclomorphosis).

Other Cladocera were more rare than *Bosmina* and *Daphnia*, although *Pseudosida* and *Holopedium* were at times quite common. Genera peculiar to a littoral habitat are discussed in the macrophyte section.

It is apparent from Tables 4.25 and 4.26, that in lake areas not widely separated, differences can be found in their plankton populations. Stations 3 and 4 supported similar populations, but they had developed independently. The upper (and sometimes the middle) basin contains the greatest density of zooplankters, both being larger than populations in the lower basin. In addition, the percentage of Cladocera of the total zooplankton population could be nearly identical (cf. 15 June), or vary markedly (cf. 24 June), from station to station.

TABLE 4.24:

Zooplankton in Lake Monroe
June - August 1974.

Protozoa
*Codonella
*Ceratium
*Difflugia cristata
*peritrich

Rotifera
Ascomorpha
Asplanchna
Brachionus
Colurella
Conochilus
Filinia
Gastropus
*Kellicottia
*Keratella cochlearis
Polyarthra euryptera
*Polyarthra vulgaris
Rotatoria
Trichocerca

Cladocerna
+Alona sp.
+Alonella sp.
*Bosmina coregoni
Ceriodaphnia lacustris
+Chydorus sphaericus
*Daphnia laevis
*Daphnia retrocurva
Diaphanosoma leuchtenbirgeanum
*Holopedium gibberum
Leptodora kindtii
+Pleuroxus denticulatus
*Pseudosida bidentata
+Sida crystallina

Copepoda
*Cyclops (2 sp.)
Limnocalanus
*Diaptomus

Ostracoda

*most commonly encountered organisms

+Cladocera associated primarily with aquatic plants

Table 4.25:

Zooplankton Organisms/m^3 from integrated vertical samples (15 June 74)

	(Middle Basin) Station 3	(Upper Basin) Station 4
Codonella	3125	7500
Ceratium	143000	100000
Keratella	6250	11250
Polyarthra	2344	8750
Trichocerca	781	3750
Colurella	781	-
Bosmina	30500	38750
Daphnia retrocurva	3125	-
Holopedium	3125	-
Nauplius larvae	14060	8750
Cyclops	2344	-
Diaptomus	781	-
Totals	170216	178750
% Cladocera	21.6	21.7

TABLE 4.26:

Zooplankton from an integrated vertical sample, 28 June 74, organisms/m^3

	(Upper Basin) Station 4	(Middle Basin) Station 3	(Lower Basin) Station 1
Codonella	2500	2083	2273
Ceratium	110000	162500	71590
Keratella	8750	6250	5680
Polyarthra	2500	13540	5110
Trichocerca	-	-	-
Filinia	2500	1042	3409
Conochilus	-	14580	1136
Kellicottia	-	-	568
Bosmina	26250	15625	23925
Daphnia retrocurva	6250	-	5110
Daphnia laevis	-	1042	-
Pseudosida	1250	-	568
Holopedium	1250	-	2841
Nauplius	10000	7292	4545
Cyclops sp. 1	1250	-	-
Cyclops sp. 2	1250	-	-
Diaptomus	2500	1042	-
Ostracod	-	4170	-
Chaoborus	-	-	-
Total	176250	229166	131755
%Cladocera	19.8	7.3	28.4

TABLE 4.27:

Vertical Variation in Zooplankton (organisms/m^3) at Station 1. Lower Basin, 28 June 1974.

	0 meters	3 meters	6 meters
Codonella	595	426	2261
Ceratium	20635	14347	67154
Keratella	6350	4830	7980
Polyarthra	1885	4260	5850
Trichocerca	-	142	133
Filinia	-	142	266
Conochilus	1190	3125	7048
Kellicottia	595	-	-
Bosmina	3175	20170	9574
Daphnia retrocurva	290	2273	798
Daphnia laevis	-	852	931
Pseudosida	-	284	266
Holopedium	992	568	665
Nauplius	4266	2840	3058
Cyclops sp. 1	-	142	133
Cyclops sp. 2	-	426	665
Diaptomus	198	1562	133
Chaoborus	99	-	-
Totals	40270	56389	106915
% Cladocera	11.1	51.7	11.4

Vertical variation in populations was also found (Table 4.27). Certain zooplankters are capable of dramatic vertical movements, usually away from the surface during the day and towards it at night, which further complicates the pattern of their distribution. Cladoceran peaks during daylight hours were commonly at 2-3 meters. As lake water transparency increased during summer, their peak occurrence was at greater depths. Similar results were found in 1971 (Allanson et al., 1973).

Similar consequences to that suggested for phytoplankton species diversity, following nutrient additions, apply here as well. Large increases in numbers of a few species and a lower number of total species present would be expected. The diverse congregation of zooplankters is indicative of low nutrient conditions. The occurrence of the genus Holopedium in the lake suggests a low calcium content and oligo- or mesotrophy (Flossner, 1972). Secchi disc transparency in a Holopedium lake should be at least 1.8 meters (which it is). Leptodora, also, by its presence implies similar conditions. With greater nutrient loading per area of lake surface, surface blooms of blue-green algae would develop. The resultant light attenuation from these blooms would deny sufficient light to certain forms and alter the composition of the phytoplankton. In turn, any changes in the phytoplankton would involve the replacement of some zooplankters (e.g., Holopedium) with more tolerant forms. The increased eutrophy would place more biomass in undesirable forms and reduce the energy available to fishes.

3. Bacterioplankton

Studies of bacteria in the lower basin were made by Smith in 1971 (Allanson et al., 1973). She found a predominance of Gram negative organisms. Gram positive organisms (*Corynebackterium, Micrococcus, Staphylococcus*) rarely exceeded 25% of the total bacterial population. Of the Gram negative organisms, only two were facultative aerobes. *Shigella* and *Salmonella*, both enteric pathogens, showed maxima of 5.2 and 2.5 percent of the total population, respectively. Obligate aerobes (*Pseudomonas, Achrobacter, Alcaligenes, Flavobacterium*) normally comprised greater than 80% of the total bacteria.

4. Benthos

No studies on benthic animals have been conducted on Lake Monroe. Shallow-water insects are an important prey item for fishes, incorporating animal or plant tissue into larger mass units. Tubificids, and chironomids as well, serve as food sources; in addition, they may have profound effects on the sediment through which they burrow, recycling materials from the rich organic deposits (Davis, 1974).

5. Macrophytes

Aquatic plant distribution and development in 1974 was very similar to that found in 1971 (Allanson et al, 1973), yet much different from that encountered in 1972 by Docauer (1972). (See Figures 4.13 and 4.14). Macrophytes were well-developed in the relatively shallow upper basin, especially in the North and

Middle Forks of Salt Creek. Allanson et al. (1973) described two separate communities: a *Potamogeton-Najas-Myriophyllum-Ceratophyllum* association found in open water and a *Sagitaria-Potamogeton-Najas* grouping in sheltered cover. The *Sagittaria* community was found along the margins of the upper and middle basins, and off the western shore of the lower basin (near the Fourwinds Marina).

In addition to the plants described in Allanson, *Najas quadalupensis* was found to be widespread. It was distributed across nearly the entire bottom of the lower basin, with the exception of the deeper channels, probably due to the increased light penetration at Station 1 (see section on Secchi disc transparency).

An above-average rainfall in spring would increase reservoir water level and turbidity resulting in later, and perhaps less, weed development. Conversely, low stages would permit increased weed growth.

In 1974, dense growths of *Myriophyllum* were found in the upper basin. Weed beds developed slowly until July and then increased rapidly. The *Myriophyllum* beds appear to be extremely important to the reservoir, acting as sediment traps of the silty flow from the North Fork. Plans to decrease weed beds by various means, whether for better fishing success or water quality, appear unwise in light of recent evidence (Mulligan, 1969; Peterson, Smith, and Malueg, 1974). Aquatic plants have been demonstrated to have an antagonistic or antibiotic effect on algae (Hasler and

Figure 4.13: 1971 and 1974 Macrophyte Beds of Monroe Reservoir-Darkened

Most observations were from above the causeway.
Most shallow coves had growth to two meters in depth.

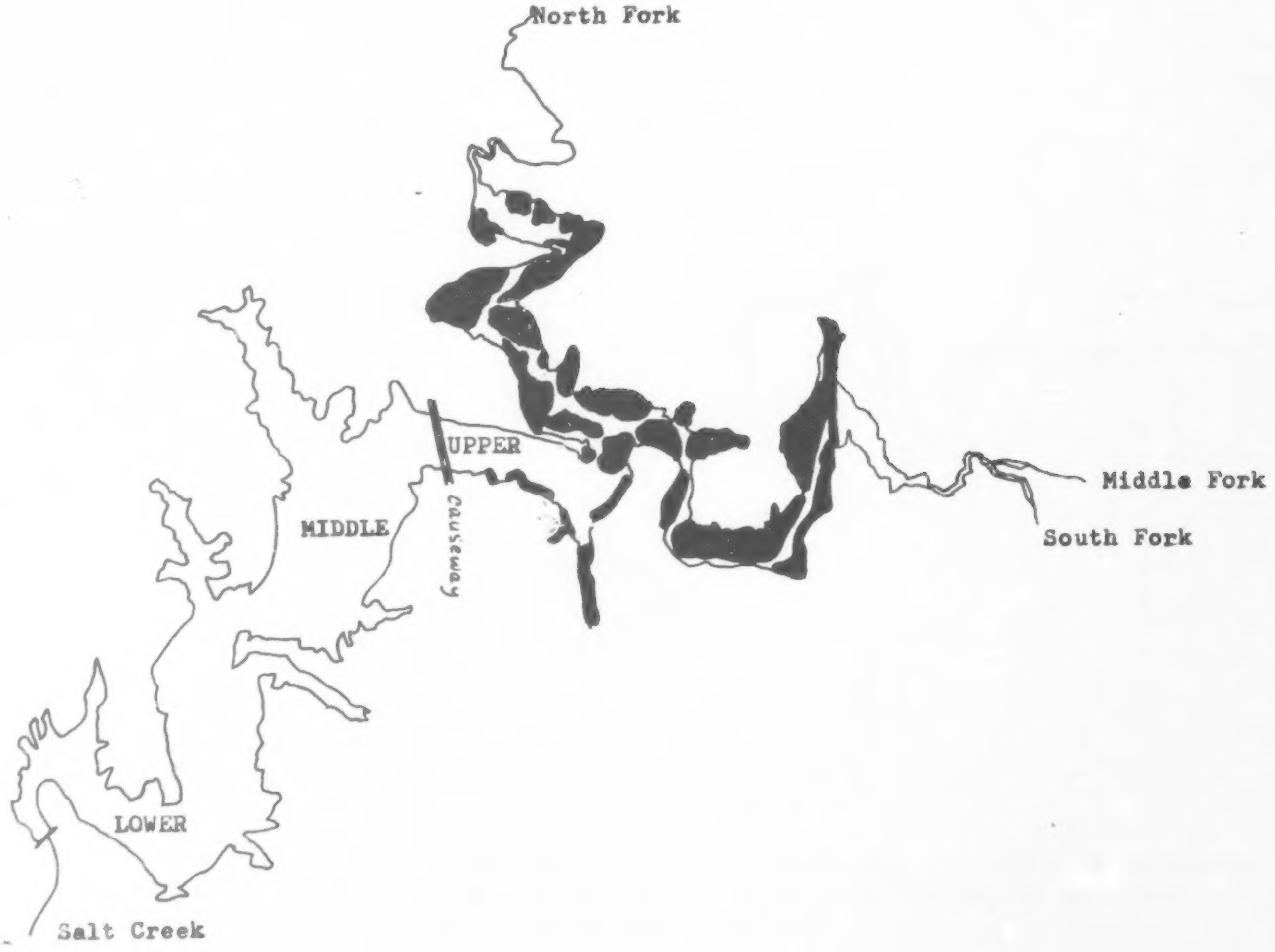
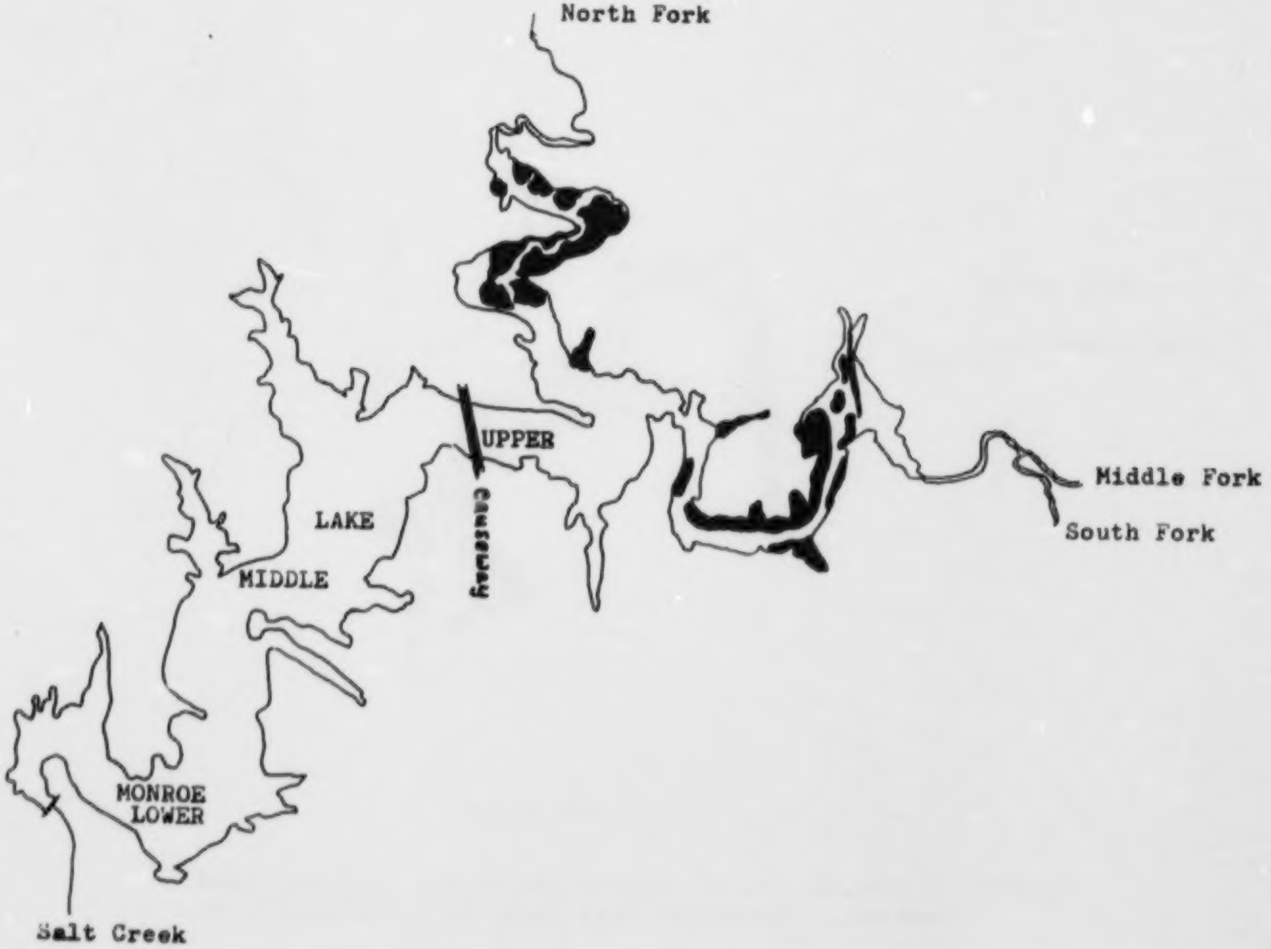

North Fork
Middle Fork
South Fork
UPPER
Causeway
MIDDLE
LOWER
Salt Creek

Figure 4.14: Monroe Reservoir - Showing the Three Basins

1972 Macrophyte Beds-Darkened
Most observations were from above the causeway
Most shallow coves had growth to a one meter depth.


North Fork
UPPER
Causeway
LAKE
MIDDLE
MONROE
LOWER
Middle Fork
South Fork
Salt Creek

Jones, 1949; Fitzgerald, 1969). Large blooms of the noxious blue-green algae Anabaena and Microcystis have resulted following weed removal (Brakke, 1974).

Primary production in Myriophyllum is mainly accomplished by only the active photosynthetic leaves forming a canopy near the water surface. The factors most important in Myriophyllum net production are light penetration and the distribution of leaf tissue (Adams, Titus, and McCracken, 1974).

In addition to macrophyte production, there is also an additional utilization of nutrient inputs and production by the abundant growths of attached periphyton (especially diatoms). Macrophytes and their associated periphyton act together as a complex, and compete with the phytoplankton for available nutrients.

Aquatic plants are colonized by an algal-fungal-bacterial assemblage. In turn, this grouping serves as a substrate for a very diverse community of animals that either graze on the periphtic algae and bacteria or prey upon other animals. (All of these organisms are collectively referred to as Aufwuchs.) Further, the diverse animal community appears to be very important as a food source for fish fry and fingerlings.

The animal component of the Aufwuchs, identified from a 29 June 1974 sample, were collected from a Myriophyllum bed. They included: Cladocera (Daphnia retrocurva, Chydorus sphaericus, Pleuroxus denticulatus, Sida crystallina, Bosmina coregoni), copepods (Cyclops), snails, several species of rotifers, ostracods, midges, damselflies and the oligochaete worm, Chaetogaster. Cladocera were not abundant in the June sample, but showed increases in September.

6. Fish

Fish stocking began in November 1964, and was completed in December 1965. Table 4.28 shows a list of species and numbers of fish introduced.

On January 1, 1967, Monroe Reservoir was opened to fishing. Annual surveys were conducted for 1968, 1969, and 1970 and 1971 by the Fishery Research section, Indiana Department of Natural Resources, Division of Fish and Wildlife.

Table 4.29 shows species composition and relative abundance of fish collected in Monroe Reservoir.

Bluegill is the only sunfish species of any significance to the fishery. Others are so few in number that they contribute little except as forage. Bluegill population growth was high. Yellow perch are increasing rapidly due to lack of predation upon them and what appears to be ideal habitat. Crappie numbers fluctuate to some extent but are high enough to provide good fishing. Although channel catfish reproduction seems to be limited, an excellent channel cat fishery exists. Carp and suckers appear to have no threat to the fishery; however, an adequate predator population must be maintained.

Monroe Reservoir is following the typical aging pattern. The bass population, which was larger, is now decreasing, a

TABLE 4.28:
Species, size, number and number per acre of fish stocked in Monroe Reservoir.

Species	Size	Number	Number/acre
Large mouth bass	6.0-12.5 in.	14,821	1.38
Blue-gill	4.0-7.0 in.	2,816	0.26
Channel catfish	6.0-22.0 in.	113,275	10.54
Flathead catfish	1.0-25.0 lbs.	433	0.04
Red ear	5.0-6.0 in.	56	<0.01
Northern Pike	1.0-25.0 in.	48	<0.01
Black crappie	9.0-12.0 in.	87	<0.01

Source: Ridenour, 1972.

TABLE 4.29:
Species Composition and Relative Abundance of Fish
Collected in Monroe Reservoir, 1968-1971.

	PERCENT OF SAMPLE			
SPECIES	1968	1969	1970	1971
Largemouth bass	37.3	26.2	18.1	23.7
Bluegill	16.2	38.8	24.7	35.5
White crappie	0.9	8.9	23.5	4.6
Black crappie	0.4	*	0.7	2.9
Yellow perch	6.4	3.7	11.0	16.9
Yellow bass	*	*	3.4	0.6
Carp	0.3	1.7	2.4	1.5
Black bullhead	0.3	2.0	1.5	*
Yellow bullhead	9.0	0.4	1.5	0.1
Channel catfish	3.5	1.9	1.0	1.2
White sucker	9.6	4.0	4.9	4.4
Spotted sucker	0.1	3.7	3.1	0.5
Redear sunfish	0.7	0.7	0.6	1.6
Pumpkinseed	*	*	0.4	*
Longear sunfish	*	1.4	1.0	3.3
Green sunfish	4.9	2.2	0.6	0.6
Warmouth	3.4	1.5	1.4	1.9
Orange-spotted sunfish	0.1	**	*	0.1
Redhorse	0.6	0.2	0.1	0.1
Rockbass	0.2	0.1	*	*
Smallmouth bass	*	**	*	*
Flathead catfish	*	**	*	*
Northern pike	0.1	*	*	*
Total Number of Fish in Sample	3,103	2,298	2,491	856
Total Number of Species Represented	18	19	18	17

*None collected.

**Less than 0.1 per cent collected.

Source: Ridenour, 1972.

phenomenon that occurs in artificial reservoirs. The 1972 fishery survey (Ridenour, 1973) indicated the following order of abundance: bluegill (30.59%), yellow perch (18.38%); largemouth bass (15.23%), yellow bass (5.56%), warmouth (??), carp (3.98%), golden shiner (??); redear sunfish (3.5%) white and black crappie (5%); bullheads (brown, yellow, black) (5%), channel catfish (0.96%). This suggests that Lake Monroe will sustain a good bass population for a longer period of time.

Yellow perch and yellow bass, which do not have the habitat preference of largemouth bass, are potential threats to Monroe's fishery. Predator-prey relationships between northern pike and yellow perch and between walleye and both yellow perch and yellow bass suggests that stocking northern pike fingerlings and walleye fry in Lake Monroe may be a solution (Ridenour, 1972).

E. SUMMARY

(1) Watershed -- Nashville, Indiana is a major point source of nutrients on the North Fork. Other sources may contribute heavily, especially during spring rains. A regional land- and water-use management is advised.

(2) Lake Monroe Morphometry -- Three distinct, major basins are present; mean depth increases from the pond-like upper basin (above the causeway) to the lower basin (near the dam).

(3) Nutrients -- Phosphorus and nitrogen in 1974 were lower than previously reported.

(4) Thermal Stratification -- Cool weather in mid- to late-summer may bring about isothermal conditions and result in partial or complete circulation. Allanson et al. (1973) showed stratification into October in 1971.

(5) Chemistry -- Hydrogen ion concentrations and conductivity have not changed much since 1968 or 1971. Alkalinity results did not agree (1971 results are in error by a factor of 2X).

(6) Secchi Disc Transparency -- A decline in mean transparency indicates increases in turbidity from 1971-1974, from added phytoplankton or non-biological particulate matter. Continuous study of plankton and sedimentary conditions is advised.

(7) Bioassay -- Experiments demonstrate that in spring algal growth is limited by phosphorus concentrations and not retarded by nitrogen. In fall, (October 1974) growth was limited primarily by phosphorus; additions of nitrate enhanced phytoplankton development.

(8) Chlorophyll -- A strong negative correlation occurred between chlorophyll _a_ and soluble reactive phosphorus and also with reactive silicates. This indicated a fast uptake of reactive phosphorus and silicates by the phytoplankton.

(9) Plankton -- Need for a continuation of studies on seasonal succession and other quantitative aspects of both phytoplankton and zooplankton.

(10) Benthos -- Need for initiation of studies on benthic animals and secondary production in general.

(11) Macrophytes -- Aquatic plants, especially in the shallow, upper basin, appear to effectively compete with the phytoplankton for available nutrients. Decreases in weed distribution would result in increased phytoplankton density.

(12) Trophic Status -- Lake Monroe is a low alkalinity, oligotrophic system. Whole lake experiments have shown that lakes of this type are quite sensitive and respond rapidly to phosphorus enrichment (Schindler, 1974). Steps must be taken to avoid phosphorus effluents from entering the reservoir.

Research is currently underway under the directorship of Dr. David G. Frey with student assistance to establish the following: (1) a general study of the watershed and lake to provide a baseline for observing the rate and duration of biological changes; (2) an understanding of the lake's biology useful in predicting the probable importance in biotic changes connected primarily with eutrophication; and (3) special studies to contribute original information to reservoir biology.

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APPENDIX C

DISCHARGE MONITORING REPORT

[illegible]

Form Approved
OMB NO. 158-R0073

U.S. FOREST SERVICE
WAYNE - HOOSIER NATIONAL FOREST
HARDIN RIDGE RECREATION AREA

(2-3) ST	(4-10) PERMIT NUMBER	(17-19) DIS	SIC	LATITUDE	LONGITUDE
IN	IN 0024953			39°00'-53"	86°27'-19"

REPORTING PERIOD FROM (20-21) YEAR 75 (22-23) MO 04 (24-25) DAY 01 TO (26-27) YEAR 75 (28-29) MO 07 (30-31) DAY 01

INSTRUCTIONS

1. Provide dates for period covered by this report in spaces marked "REPORTING PERIOD".
2. Enter reported minimum, average and maximum values under "QUANTITY" and "CONCENTRATION" in the units specified for each parameter as appropriate. Do not enter values in boxes containing asterisks. "AVERAGE" is average computed over actual time discharge is operating. "MAXIMUM" and "MINIMUM" are extreme values observed during the reporting period.
3. Specify the number of analyzed samples that exceed the maximum *(and/or minimum as appropriate)* permit conditions in the columns labeled "No. Ex." If none, enter "O".
4. Specify frequency of analysis for each parameter as No. analyses/No. days. *(e.g., "3/7" is equivalent to 3 analyses perfomed every 7 days.)* If continuous enter "CONT."
5. Specify sample type *("grab" or "___ hr. composite")* as applicable. If frequency was continuous, enter "NA".
6. Appropriate signature is required on bottom of this form.
7. Remove carbon and retain copy for your records.
8. Fold along dotted lines, staple and mail Original to office specified in permit.

(32-37) PARAMETER		QUANTITY (3 card only) (38-45) MINIMUM	QUANTITY (46-53) AVERAGE	QUANTITY (54-61) MAXIMUM	UNITS	(62-63) NO. EX	CONCENTRATION (4 card only) (38-45) MINIMUM	CONCENTRATION (46-53) AVERAGE	CONCENTRATION (54-61) MAXIMUM	UNITS	(62-63) NO. EX	(64-68) FREQUENCY OF ANALYSIS	(69-70) SAMPLE TYPE
	REPORTED												
	PERMIT CONDITION												
5-DAY BOD	REPORTED							3.2	7.7	mg/l	0	1/7	GRAB
	PERMIT CONDITION							10	15				
SUSPENDED SOLIDS	REPORTED							3.4	8.5	mg/l	0		
	PERMIT CONDITION							10	15				
FECAL COLIFORM BACTERIA	REPORTED								0	COL./100 ml	0		
	PERMIT CONDITION								200				
RESIDUAL CHLORINE	REPORTED								0.5	mg/l	0		
	PERMIT CONDITION								0.5				
pH	REPORTED						6.7		8.1	pH	0		
	PERMIT CONDITION						6.5		8.5			↓	↓
	REPORTED												
	PERMIT CONDITION												
	REPORTED												
	PERMIT CONDITION												

NAME OF PRINCIPAL EXECUTIVE OFFICER	TITLE OF THE OFFICER	DATE
GIRTON DONALD S. LAST FIRST MI	FOREST SUPERVISOR TITLE	75 07 28 YEAR MO DAY

I certify that I am familiar with the information contained in this report and that to the best of my knowledge and belief such information is true, complete, and accurate.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

PAGE OF

EPA Form 3320-1 (10-72)

ORIGINAL

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APPENDIX D

LAKE MONROE LAND SUITABILITY STUDY

EXECUTIVE SUMMARY

Indiana University
School of Public Environmental Affairs
Center for Urban and Regional Analysis
July 1975

PREFACE

The purpose of this Executive Summary is to provide a concise, easily read review of the major points of the Lake Monroe Land Suitability Study Technical Report for the benefit of elected and appointed officials as well as other persons with a general interest in the topic.

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* Maps Identified In The Executive Summary Have Not Been Reproduced In This EIS.

INTRODUCTION

- ☐ DESCRIPTION OF THE LAKE MONROE WATERSHED
- ☐ STUDY AREA DEFINED
- ☐ RESERVOIR PURPOSES
- ☐ THE DEMAND FOR USE

DESCRIPTION OF THE LAKE MONROE WATERSHED

Monroe Reservoir, with a surface area of 10,750 acres, is the largest impoundment of water in Indiana. It is situated in the south-central part of the state, about ten miles south and east of Bloomington. The major portion of the reservoir lies within Monroe County with the upper end of the reservoir extending into Brown and Jackson Counties. A very small part of the reservoir's drainage area lies in Lawrence County.

The reservoir occupies the main valley of Salt Creek and extends into several tributary valleys. From the reservoir, Salt Creek flows southwesterly through Lawrence County to its confluence with the East Fork of the White River about five miles southwest of Bedford, Indiana. The drainage area of the Salt Creek basin is 647 square miles, of which 441 square miles lie upstream from the damsite. The dam is located 25.6 miles above the mouth of Salt Creek, about two miles east of Harrodsburg in Monroe County.

STUDY AREA DEFINED

The specific focus of the geology, ecology, and land use studies of this report was an area of approximately 100 square miles immediately surrounding the lake (see Map 1). The institutional study describes the jurisdiction of county, regional, state, and federal agencies within the entire Lake Monroe drainage basin.

RESERVOIR PURPOSES

Monroe Reservoir was constructed for two primary purposes:

- Flood control
- Low flow augmentation of Salt Creek below the dam and the East Fork of the White River

The reservoir's secondary purposes are:

- Recreation
- Fish and wildlife
- Water supply

THE DEMAND FOR USE

Since 1965, the demand for the multiple use of Lake Monroe beyond the original purposes has grown considerably. As a result, the following are emerging:

- Lake Monroe provides drinking water to Bloomington and Bedford. It is estimated that the City of Bloomington, alone, will have an average daily use of 12 million gallons per day by 1980 and 16 million gallons per day by 1990. Maximum daily use is expected to be 21 million gallons in 1980 and 28 million gallons in 1990. The available pool can supply 36 million gallons per day.

- A "major center of commerce" has been predicted for the Lake Monroe region due to the presence of Lake Monroe and the attractiveness of other recreational sites nearby. Tourism and recreation are already major industries in the area. Development of numerous residential areas are proposed.

- Eutrophication and other deterioration of the lake may be significantly accelerated due to human activities around the lake. The usual resultant problems of prolific weed and algal growth, deteriorating fisheries, impaired water quality, and sediment infilling may pose a serious threat to the utilization of the lake.

GEOLOGY

☐ GENERAL INFORMATION

☐ GEOLOGIC DESCRIPTION OF THE AREA

☐ SOIL MATERIAL CHARACTERISTICS

☐ LAND-USE CONSIDERATIONS

GENERAL INFORMATION

The geologic and soil conditions of an area are important factors in determining the suitability of land for a particular use. Among the land-use factors that are directly affected by the underlying geology are:

- Suitability for septic tank waste disposal
- Foundation and excavation conditions
- Slope stability
- Ground water availability

The purpose of this section is to identify basic geologic features of the Lake Monroe area and to relate them to these land-use factors. Many other land-use factors, such as soil fertility, tree growth rates, and erosion hazard, also are influenced by geologic features and are discussed in other sections of this report.

GEOLOGIC DESCRIPTION OF THE AREA

In parts of the Lake Monroe study area, bedrock is the most important geologic element and the overlying soil materials are directly related to the bedrock. In other parts, soil materials are not directly related to the underlying bedrock and the soil materials themselves are the most important geologic element.

There are principally two types of bedrock in the Lake Monroe study area: limestone and siltstone. Siltstone bedrock underlies much of the eastern part of the study area, whereas limestone bedrock underlies some of the central and most of the western part of the area. The two bedrock areas are subdivided based on steepness of topography into areas of less than 20 percent slope and areas of more than 20 percent slope. These are shown on the geologic map (Map 2) as:

- Area I: Limestone bedrock and less than 20 percent slope
- Area II: Limestone bedrock and greater than 20 percent slope
- Area III: Siltstone bedrock and less than 20 percent slope
- Area IV: Siltstone bedrock and greater than 20 percent slope

Parts of the study area where soil materials are not directly related to bedrock are divided into two map Areas (Map 2):

- **Area V:** Valley-flanking terraces along Salt Creek and its tributaries
- **Area VI:** Flat bottomland areas underlain principally by stream-deposited materials

Areas severely disturbed by man are shown (Map 2) as:

- **Area VII:** Quarries, rock cuts, fills, and other disturbed areas

These seven Areas differ in geologic characteristics and land-use capability. Many geologic characteristics such as slope, depth to bedrock, and soil texture vary somewhat within each Area. The discussion that follows is in terms of these Areas.

SOIL MATERIAL CHARACTERISTICS

Thickness of soil materials in the study area ranges from a few inches to more than 70 feet. The thicker soils generally are in areas of the gentler slopes; the thickest soils are in terrace or valley-bottom positions. The soil materials specific to each area are as follows:

Area	Soil Materials
I	0-5 feet of silt loam and silty clay loam overlying up to 20 feet of plastic silty clay and clay, slightly stony in places
II	0-2 feet of silt loam and silty clay loam overlying up to 5 feet of plastic silty clay and clay, stony in places
III	0-10 feet of silt loam and silty clay loam with some silty clay at depth, slightly stony
IV	0-3 feet of silt loam and silty clay loam, very stony
V	Contains a complex of soil materials ranging from 5 to 70 feet in thickness, mostly silt loam with some pebbly, sandy loam, sandy clay loam, and loamy sand at depth
VI	Generally silt loam but contains some clay rich zones, stony or pebbly in places

LAND-USE CONSIDERATIONS

The geologic features of the Lake Monroe study area importantly influence four land-use factors:

On-Site Septic Disposal

Adverse geologic and soil conditions are important factors leading to the failure of private septic tank waste disposal systems. Overloading of the drainfield is the primary cause of failure, and conditions that cause overloading are in many ways tied to the geologic and soil conditions. The following factors influence the effectiveness of the drainfield:

- Permeability and thickness of the soil
- Highest seasonal water table
- Slope of the land

The geologic data indicate that much of the study area is unsuitable for private septic tank waste disposal. Specifically:

- All of Areas II and IV are unsuitable for septic tank disposal because of excessive slope. Area VI is unsuitable because of high water table and/or frequent flooding.
- Use of septic tanks in parts of Area I and parts of Area V is limited by the presence of impermeable fragipan or heavy clay zones in the soil.
- Area I is underlain by cavernous bedrock. Therefore, pollution of local ground water supplies may result if the septic systems fail.
- Parts of Area III are suitable for septic tanks, dependent on local slope, water table depth, and soil thickness.

Foundation and Excavation Conditions

Many geologic and soil factors influence the type and design of footings and foundations for buildings. In particular, the following factors should be considered in foundation design:

- Slope of the land
- Depth and type of bedrock
- Water table conditions
- Soil drainage
- Strength, compressibility, and shrink-swell capacity of the soil

Parts of the study area are potentially hazardous for residential and light commercial construction because of one or more of the above factors (larger industrial buildings require a much more detailed analysis of soil conditions than has been presented in this study).

- Areas I and II, which are underlain by limestone, present two potential building problems. The bedrock surface is irregular and rock that is difficult to remove may be encountered in basement excavations. In addition, clay and silty clay in the subsoil possess high shrink-swell properties that may cause damage to footings and foundations unless adequate soil drainage is provided.
- Area III is underlain in places by soft consistency materials of low bearing capacity.
- Area VI has a high seasonal water table and the possibility of surface flooding.
- Areas II and IV have bedrock at shallow depth and slopes which are too steep for most conventional types of construction.

Slope Stabiity

Some parts of Area IV and adjacent parts of Area V are prone to landslides, particularly along cut slopes parallel to hillsides where soil material is removed by excavation. This leaves material on the slope above the excavation with no lateral support. Slope stability problems in Area IV result from steep slopes and impermeable bedrock at shallow depth. Foundations, roads, utility lines, and other kinds of construction should be designed so as to avoid problems with this kind of earth movement.

Ground Water

The same geologic features that make the study area an excellent location for a reservoir also make it an area of very limited ground water supply. As a result, nowhere in the study area are ground water sources abundant enough for more than private residential use.

- In the eastern and central parts of the area, wells completed in siltstone are dry or yield water at only a few gallons per hour.
- In the western part of the area, wells completed 100 to 150 feet through the limestone into the top of the underlying siltstone generally have yields adequate for single family domestic use. In the limestone area, however, pollution of the ground water by effluent from faulty septic tank systems is common.
- Soil materials of the terrace and valley-bottom areas (Areas V and VI) are insufficiently permeable to yield water in usable quantity.

TERRESTRIAL ECOLOGY

- ☐ GENERAL INFORMATION
- ☐ FORESTS
- ☐ WILDLIFE
- ☐ FOREST AND WILDLIFE MANAGEMENT
- ☐ LAND-USE CONSIDERATIONS

GENERAL INFORMATION

The forests surrounding Lake Monroe are one of the most valuable assets of the region. Land uses such as outdoor recreation, timber production, wildlife management, watershed management, and the life of the reservoir itself, all depend, directly or indirectly, on these forested lands.

The purpose of this section is to identify the structure and composition of these forests and to indicate the importance of the forests to land-use considerations. In addition, the wildlife common to the area will be discussed.

FORESTS

To help identify the structure and composition of the forested areas, a generalized vegetation map (Map 3) was compiled to show the extent and location within the study area of the following:

- Early "old field" successional vegetation
- Young successional or disturbed forests
- Mature forests

Analysis of forest species composition, on the basis of the vegetation map and the data obtained from field surveys, revealed that the forests of the Lake Monroe region have remained very much the same in species composition as that of pre-settlement time, namely, Beech-Oak-Maple-Hickory forests. This type of vegetation is not extensive in southern Indiana and is one of the most interesting plant communities of the state because of the great number of species sharing dominance.

WILDLIFE

Due to its ruggedness and sub-marginal value for farming, much of the Lake Monroe region has remained forested. As a result, an abundance of wildlife exists within the area, including:

- 50 species of amphibians and reptiles
- 40 species of mammals
- 30 species of birds which are common permanent residents, 55 which are common summer residents, 15 which are common winter residents, and 64 which are common migrants

It should also be noted that two species of birds occurring in the Lake Monroe region have sub-species (the Southern Bald Eagle and the Peregrine Falcon) which are classified as "endangered" by the Department of the Interior. Although the sub-species have not actually been sighted in the Lake Monroe region, their range does encompass the area.

FOREST AND WILDLIFE MANAGEMENT

A large extent of the forested areas in the Lake Monroe region are public lands under the supervision of the National Forest Service and the Division of Fish and Wildlife. These agencies currently have management programs which utilize the forests for multiple purposes including:

- Timber production
- Soil and water conservation
- Wildlife protection and production
- Outdoor recreation

LAND-USE CONSIDERATIONS

Land-use changes in the Lake Monroe region can be expected in the future, especially in the immediate vicinity of the lake. When such changes require extensive clearing and construction, terrestrial ecosystems will be affected. Of particular importance is the clearing of forested areas which often results in accelerated runoff and erosion. Forests help retard runoff and erosion because:

- The forest canopy intercepts the falling rain and diminishes the energy of impact.
- The canopy, understory vegetation, and leaf litter layer are effective in absorbing rainfall.
- Forest soils typically absorb large quantities of water rapidly.

Since much of the Lake Monroe region is characterized by steep slopes and erodible soils, the extensive forests present in the area are clearly important in retarding runoff and soil erosion as well as moderating stream flow and sediment discharge into the reservoir. This should be kept in mind when major land-use changes are proposed.

AQUATIC ECOLOGY

- ☐ GENERAL INFORMATION
- ☐ PHYSICAL-CHEMICAL PROPERTIES
- ☐ ORGANISMS
- ☐ LAND-USE CONSIDERATIONS

GENERAL INFORMATION

Monroe Reservoir is a shallow lake with a mean depth of 10-13 feet and a surface area of approximately 10,750 acres. The lake is comprised of three distinct basins (see Figure 1), with the mean depth increasing from the pond-like upper basin (above the causeway) to the lower basin (near the dam). The old Salt Creek channel meanders across the bottom of the reservoir as a 23-36-foot trench.

PHYSICAL-CHEMICAL PROPERTIES

The physical and chemical conditions within any body of water largely determine what aquatic communities can exist within it. While there are many different physical and chemical characteristics that can be discussed, only several of the more important ones will be dealt with here.

Transparency

Suspended materials can interfere with the penetration of light into water by scattering and absorbing the rays. If enough suspended material is present, the water will become turbid and, as a result, the photosynthetic zone will become restricted. A comparison of transparency readings taken from 1968 to 1971 with the readings obtained in the Land Suitability Study reveals that there is a decline in the mean transparency of the lake. Two possible explanations for this are: (1) an increase in planktonic populations as a result of nutrient additions and (2) an increase in suspended soil particles and other non-biological particulate matter.

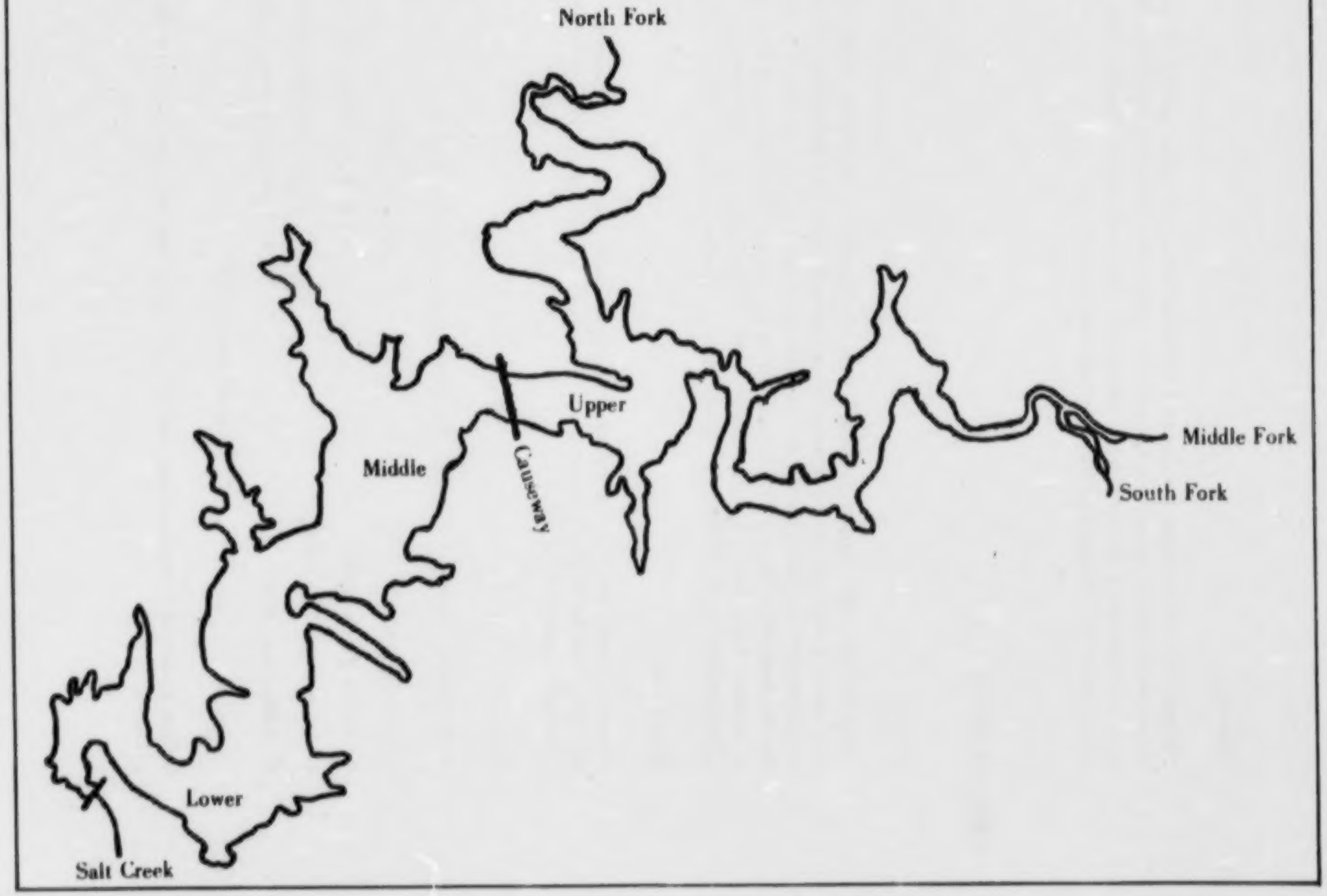
Oxygen

Oxygen is important to the survival, reproduction, and growth of a variety of aquatic organisms, most notably fish. Oxygen is also an essential element for the decomposition of organic materials. When organic materials are present in relatively large quantities in the water, the demand for oxygen by microorganisms to decompose these materials is high. Under such conditions, oxygen depletion may result and this, in turn, may have a deleterious effect upon fish and other organisms.

The Land Suitability Study shows that the dissolved oxygen levels are not significantly different from those obtained in the 1968-71 study. Only in the deeper Salt Creek channel does serious oxygen depletion occur, and the relative volume of this old creek bed is minor in comparison to the three basins.

FIGURE 1

Monroe Reservoir—Showing The Three Basins


North Fork
Upper
Middle Fork
South Fork
Middle
Causeway
Lower
Salt Creek

Nutrients

Phosphorous and nitrogen are essential nutrients for aquatic plant growth. When present in large quantities, however, these nutrients can cause unnatural enrichment of the lake, commonly referred to as eutrophication. Readings taken during the course of the Land Suitability Study indicate that phosphorous and nitrogen levels in the lake are generally low.

ORGANISMS

Plankton

Tests indicate that nutrient loadings above the current levels would serve to bring about the dominance of fewer species and a decrease in community diversity and stability of phytoplankton and zooplankton within Lake Monroe. An increase in phosphate content, in particular, would likely lead to the development of large surface blooms of blue-green algae. These blooms would deny sufficient light to certain forms and alter the composition of phytoplankton. In turn, any changes in the phytoplankton would involve the replacement of some zooplankters with more tolerant forms.

Macrophytes

Aquatic plants, especially in the shallow upper basin, appear to compete effectively with the phytoplankton for available nutrients. Any decrease in weed distribution would most likely result in increased phytoplankton density.

Fish

A 1972 survey indicated that Lake Monroe contains the following fish:

- Bluegill (31%)
- Yellow Perch (18%)
- Largemouth bass (15%)
- Yellow bass (6%)
- Carp (4%)
- Redear sunfish (4%)
- White and black crappie (5%)
- Bullheads (brown, yellow, black) (5%)
- Channel catfish (1%)

Golden shiner and warmouth are also present within the lake, but their abundance is currently unknown.

The fact that the bass population has not declined as much as typically occurs in artificial lakes suggests that Lake Monroe is potentially a greater producer of bass and should sustain a good bass population for a longer period of time.

LAND-USE CONSIDERATIONS

On the basis of the Land Suitability Study, Lake Monroe does not appear to be mildly eutrophic as suggested by the 1968-71 study. However, experiments have shown that lakes of Monroe Reservoir's nature are quite sensitive and respond rapidly to phosphorous enrichment. The resultant problems of prolific weed and algal growth, deteriorating fisheries, and impaired water quality can pose a serious threat to the utilization of the lake. Therefore, care should be taken to minimize the entrance of phosphorous effluents into the reservoir.

LAND USE

- ☐ GENERAL INFORMATION
- ☐ LAND-USE SURVEY
- ☐ LAND-USE MAPS
- ☐ LAND CAPABILITY MODEL
- ☐ LAND-USE CONSIDERATIONS

GENERAL INFORMATION

A land-use survey is carried out to provide a description of the surface utilization of an area at a certain moment in time. In essence, this type of survey provides an answer to the question, "How is the land being used in this region?" The information gathered in a land-use survey permits the construction of a land-use map. This map shows the clustering of certain uses and the stringing out of others. It shows, in total, the impact of man on the natural landscape.

The purpose of this section is to provide detailed information about the use of land around one of southern Indiana's most heavily used recreation areas—Lake Monroe. Both a land-use survey and land-use maps are employed to generate this information in a format suitable for forming the basis for future planning decisions for the Lake Monroe area.

It should be carefully noted that for the results of this section to be meaningful, it is essential that the land-use information is periodically updated. This can most easily be accomplished by institutionalizing the whole process by making it a function of an agency such as the Monroe County Planning Commission.

LAND-USE SURVEY

The classification system for the land-use survey is designed to be:

- Easily followed and understood by someone not involved in either its construction or in the actual data collection;
- Comprehensive enough so that if the decision is made to complete the land-use inventory of the entire watershed, then the original classification will need little or no modification;
- Comprehensive enough at the outset to eliminate the need for any kind of expensive and time-consuming reconnaissance study;
- Compatible with computer data processing procedures.

The land-use classification system encompasses rural as well as urban land uses. The classification has nine major categories:

- Residential
- Commercial
- Business Services
- Industrial
- Agricultural
- Communications and Transport
- Public and Quasi-Public
- Recreational and Open Space
- Forestry

Within each of these groups, further subdivisions were instituted giving a more detailed breakdown of a land-use category. (A complete listing of these categories can be found in Appendix A of the Land Use Survey section of the Land Suitability Study Technical Report.)

Data was collected using a grid system for the study area. Each section was divided into 64 ten-acre cells and these cells were the unit for which data was categorized. The data gathered in the land-use survey reveal that:

- Forests comprise 30,362 acres (63%) of the study area, of which 15,613 acres (32%) are public lands.
- Parks and recreation areas comprise 2,997 acres (6%) of the study area.
- Agriculture accounts for 6,659 acres (14%) of the study area, of which 2,494 acres (5%) are utilized croplands and 2,419 acres (5%) are abandoned croplands.
- The total number of acres classified as residential in the study area is 1,762 (4%).

LAND-USE MAPS

Two types of land-use maps have been constructed:

- A general map (Map 4) which portrays all major categories of land use;
- A set of maps showing individual land uses (refer to the Appendix in the Land Use section of the Land Suitability Study Technical Report).

When the reader examines these maps, there should be the realization that since the east side of the lake is largely in public ownership, the pressures for development will be primarily on the west side of the lake.

LAND CAPABILITY MODEL

A land capability model is being designed on the basis of the information gathered in the Land Suitability Study. This model will be a useful tool for considering alternative development proposals in terms of their environmental impact. While the model will be of particular use to the planner/analyst, it can be used by almost anyone who is willing to study carefully the Computer Model User's Manual which provides the procedure for using the model as well as the accompanying data base.

LAND-USE CONSIDERATIONS

One of the most demanding and complex issues facing the residents of the Lake Monroe region is that of land development, zoning, and the impacts of land-use change. Questions such as the following emerge:

- What is the impact of an individual development on the whole community?
- What are the legal ramifications of a given land-use decision? Will these be long-term implications?
- What are the potential costs to the community (police protection, solid waste disposal, etc.) of a new development?
- Are there environmental impacts of a given development which have not been considered?
- Is low-income housing being considered as well as high-income housing?
- What is the recreational carrying capacity of the lake and the implications of this on residential and commercial development?

This section on land use does not, and cannot, provide complete answers to these problems. It does, however, provide the basic information for land-use decision making.

INSTITUTIONAL FRAMEWORK

- ☐ GENERAL INFORMATION
- ☐ FEDERAL AGENCIES
- ☐ STATE AGENCIES
- ☐ LOCAL AGENCIES

GENERAL INFORMATION

A myriad of federal, state, and local agencies exist which have powers that directly bear on the planning and development of the Lake Monroe region. The purpose of this section is to identify these agencies and to clarify their roles as they relate to the Lake Monroe area. To assist in this process, a series of charts is presented on the following pages. While the charts discuss in some detail the functions of each agency, it should be kept in mind that these descriptions are by no means complete. The Land Suitability Study Technical Report should be consulted if a more detailed description is desired.

CHART I
FEDERAL AGENCIES

Agency Title	*Description of Powers*
Department of Agriculture	Secretary has jurisdiction over the protection of the National Forests of which Hoosier National Forest is part; has the power to establish rules and regulations to prevent forest destruction by fire or depredation and to control occupancy and use of the forests; also has the power to provide control measures for runoff, water-flow retardation, and soil erosion within the forests. Administration within Hoosier National Forest of these regulations and management programs is largely carried out by the forest supervisor.
Corps of Engineers	Proposed and constructed Lake Monroe; currently responsible for the management of flood control and public use of the reservoir; public use management includes control of boats, mooring, and sanitation, although the Corps' role in this is largely one of overseer since it is the Indiana Department of Natural Resources which actually enforces the regulations; flood control management includes maintenance and operation of the dam facility as well as approval of all improvements, excavations, and construction within the limits of the project right-of-way.
Environmental Protection Agency	Serves a wide variety of functions that relate to the overall protection of the nation's environment; of particular importance to the Lake Monroe region are: 1. The E.P.A. may grant money to prevent discharge of untreated sewage into any water, provided that the state control board approves the plan for prevention and assures proper and efficient operations. 2. The E.P.A. enforces the Federal Water Pollution Act of 1972 which regulates the discharge of all point sources of pollution through the issuance of permits (the permit authority was recently delegated to the Stream Pollution Control Board of the State of Indiana).

CHART I (Continued)
FEDERAL AGENCIES

Agency Title	*Description of Powers*
Council on Environmental Quality	Top-level advisory group to the President concerned with all aspects of environmental quality; responsible for the issuance of guidelines to federal agencies for the preparation of environmental impact statements; agency will have little direct impact on Lake Monroe region unless some federal or federally funded project is proposed that would significantly affect the quality of the environment in which case an environmental impact statement will probably have to be filed.
Department of the Interior	Protection of timber owned by the United States from fire, disease, and insects is one of many functions; Bureau of Sport Fisheries and Wildlife, a division of the Department of the Interior, exercises various powers that affect the Lake Monroe area such as the regulation of hunting seasons, methods of hunting, and trapping; protection of the wildlife in Hoosier National Forest, however, is controlled by the Forest Service of the Department of Agriculture.
Federal Power Commission	Issues licenses for the purpose of constructing, operating, and maintaining power or transmission facilities within any National Forest and across, along, or from any body of water over which Congress has jurisdiction; a license from the Federal Power Commission as well as an easement from the Secretary of Agriculture therefore appear to be necessary before power lines may be constructed in Hoosier National Forest.

CHART II
STATE AGENCIES

Agency Title	*Description of Powers*
Environmental Management Board	Role is nebulous; currently approves and directs a variety of environmentally related duties performed by the State Board of Health; primarily establishes policy and oversees the work of the Stream Pollution Control Board and the Air Pollution Control Board.
State Board of Health	Source through which the Environmental Management Board exercises authority; possesses a wide variety of powers dealing with sanitary service systems including: 1. The issuance and enforcement of orders that regulate the use of existing or proposed sanitary systems that do not meet prescribed health standards. 2. The ordering of treatment of sewage and industrial waste if it causes a health hazard. 3. Approval, in conjunction with the Stream Pollution Control Board, of proposed sewage disposal facilities. 4. Control of pollution of water supply when jurisdiction is not possessed by the Stream Pollution Control Board. 5. Enforcement of all laws and regulations concerning the character and location of plumbing, drainage, water supply, and disposal of sewage for public buildings.
Stream Pollution Control Board	Created to control and prevent pollution of the state's waters with any substance deleterious to public health; has the power to: 1. Order the construction of facilities to dispose of waste matter that is causing, contributing, or about to cause or contribute to a polluted condition. 2. Issue permits for construction or modification of any water pollution control facility.

CHART II (Continued)
STATE AGENCIES

Agency Title	*Description of Powers*
Stream Pollution Control Board (continued)	3. Administer the National Pollution Discharge Elimination System (N.P.D.E.S.) permit program for the discharge of pollutants into subsurface or surface waters of the state. 4. Establish and enforce water quality standards for most waters of the state including Lake Monroe.
Department of Natural Resources	The Department has the power to: 1. Establish rules and regulations for watercraft safety and register watercraft. 2. Protect fish and wildlife. 3. Lease state-owned lands for lodging and food facilities. 4. Set aside nature preserves and lands of cultural, scenic, or historical significance. 5. Approve the sale of timber from state lands. 6. Purchase or condemn land for construction of reservoirs as well as approve changes in shorelines of lakes. 7. Assist in the prevention of floods. Although this is not a complete listing of all the powers of the Department of Natural Resources, it demonstrates the need to consult with this department in almost any project involving Lake Monroe or its environs.
Administrative Building Commission	Enforces provisions relative to the construction, repair, or maintenance of all buildings with the exception of one- and two-family residences and agricultural buildings: the A.B.C.'s rules and regulations should always be consulted when structures are contemplated; approval of plans and specifications or variances may be necessary.
State Highway Commission	Approves all openings to state highways; constructs and maintains all existing state roads and all public roads and parking areas on the properties of the Department of Natural Resources.

CHART II (Continued)
STATE AGENCIES

Agency Title	*Description of Powers*
Public Service Commission	**Controls all public utilities and has the exclusive right to grant licenses, permits, and franchises, regulate services and fix rates; certificates of necessity and convenience may be necessary before businesses that furnish heat, light, water, power, or which collect, treat, and dispose of sewage can be established in the Lake Monroe area.**

CHART III
LOCAL AGENCIES

Agency Title	*Description of Powers*
County Commissioners	The Commissioners' primary influence on the Lake Monroe region is through the issuance of zoning regulations; the Commissioners also have the power to: 1. Buy, sell, and lease land belonging to the county. 2. Grant licenses with respect to the use of county property. 3. Maintain, change, vacate or open county highways and, if so authorized, maintain the state highways located in the county. 4. Condemn land for drainage and sewers. 5. Adopt ordinances to regulate food sanitation as well as disposal of garbage. 6. Approve all new legal drains.
County Plan Commission	Largely responsible for the enforcement of county zoning ordinances; also advises the County Commissioners concerning boundaries of districts as well as the regulations and restrictions to be enforced. Any person contemplating a project in the Lake Monroe area should consult this commission before undertaking any action.
Regional Waste Districts	A regional waste district encompasses the Monroe County segment of Lake Monroe; major functions are planning, organizing, and operating a coordinated waste disposal system.
Soil and Water Conservation Districts	These agencies provide the local land owner technical assistance and information concerning soils and erosion; the agencies have few regulatory powers and, in general, assist rather than control property owners.
County Board of Health	Performs, for the most part, the same functions as the State Board of Health.

CHART III (Continued)
LOCAL AGENCIES

Agency Title	*Description of Powers*
Municipalities	Cities and towns have been granted numerous powers allowing them to perform functions outside their corporate limits. Conceivably, this could affect Lake Monroe, since the reservoir lies within a 10-mile radius of Bloomington and several other towns.

PROJECT IDENTIFICATION

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FINANCIAL SUPPORT: Office of State Planning with the cooperation of the
Monroe County Commissioners
Mr. William Cook, President, Cook, Inc.
The City of Bloomington Utilities Board
Caslon Development

RELATED REPORTS

- Lake Monroe Land Suitability Study: A Technical Report on a Selected Portion of the Lake Monroe Watershed
- Land Capability Model for the Lower Lake Monroe Watershed
- Computer Program User's Manual

FURTHER INFORMATION

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APPENDIX E

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   07-23-75                                   NATIONAL AEROMETRIC DATA BANK                                                    15
                                              QUARTERLY FREQUENCY DISTRIBUTION
                                               STATE (15): INDIANA

SITECODE: 150380001            LOCATION: BLOOMINGTON                                          LATITUDE: 39 D. 10 M. 05 S. N
AGENCY/PROJECT: F01            COUNTY (2300): MONROE CO                                       LONGITUDE: 086 D. 32 M. 10 S. W
AGENCY TYPE: STATE             SITE ADDR: CNTPL FIRE STA OLD CITY HALL 4TH & WALNUT          UTM ZONE: 16
CITY POPULATION:      42,890   STATION TYPE (13): CENTER CITY - COMMERCIAL                    UTM NORTHING: 4335315
AQCR POPULATION:     547,365   AQCR (080): SOUTHERN INDIANA                                   UTM EASTING:    540075
EPA-REGION: 5                  SMSA (0000):                                                   ELEVATION ABOVE GROUND: 060 FT.
SUPPORTING AGENCY: INDIANA AIR POLLUTION CONTROL BOARD                                        ELEVATION ABOVE MSL: 0860 FT.
COMMENTS: SITE IS LOCATED IN CENTER OF CITY                                                   DIFF. GMT: WEST 05 HOURS
          ACTIVE 1/66

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YEAR-QUARTER  POLLUTANT
      POLLUTANT-METHOD CODE        NUM    MIN                      PERCENTILES                2ND    1ST    ARITH    GEOMETRIC
       METHOD                      OBS    OBS     10     30     50     70     90     95     MAX    MAX    AVG    MEAN  STD DEV
        INTERVAL AND UNITS
---------------------------------------------------------------------------------------------------------------------------

 73-01  PARTICULATE
      1113131                       7     23.    23.    70.    77.    87.   189.   189.   132.   189.    98.    32.15   1.94
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 73-02  PARTICULATE
      1113131                       7     28.    28.    51.    60.    64.   109.   109.    67.   109.    59.    53.63   1.60
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 73-03  PARTICULATE
      1113131                       3     57.    57.    57.    57.    66.    66.    66.    57.    66.
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 73-04  PARTICULATE
      1113131                      14     19.    27.    46.    43.    70.   105.   125.   105.   125.    60.    53.37   1.60
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 74-01  PARTICULATE
      1113131                      12     37.    47.    79.    93.   134.   157.   173.   157.   173.   100.    90.34   1.64
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 74-02  PARTICULATE
      1113131                      10     46.    46.    71.    93.    98.   106.   116.   106.   116.    66.    93.00   1.33
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)

 74-03  PARTICULATE
      1113131                      12     27.    40.    53.    57.    72.    77.    77.    77.    77.    64.    61.53   1.33
       HI-VOL  GRAVIMETRIC
        24-HOUR   UG/CU METER (25 C)
```

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     07-23-75                                NATIONAL AEROMETRIC DATA BANK                                        15
                                             QUARTERLY FREQUENCY DISTRIBUTION
                                              STATE (15): INDIANA

  SITECODE: 150380001             LOCATION: BLOOMINGTON                                  LATITUDE: 39 D. 10 M. 05 S. N
  AGENCY/PROJECT: F01             COUNTY (2300): MONROE CO                               LONGITUDE: 086 D. 32 M. 10 S. W
  AGENCY TYPE: STATE              SITE ADDR: CNTRL FIRE STA OLD CITY HALL 4TH & WALNUT   UTM ZONE: 16
  CITY POPULATION:     42,330     STATION TYPE (13): CENTER CITY - COMMERCIAL            UTM NORTHING: 4335310
  AQCR POPULATION:    547,305     AQCR (083): SOUTHERN INDIANA                           UTM EASTING:   540075
  EPA-REGION: 5                   SMSA (0000):                                           ELEVATION ABOVE GROUND: 000 FT.
  SUPPORTING AGENCY: INDIANA AIR POLLUTION CONTROL BOARD                                 ELEVATION ABOVE MSL: 0800 FT.
  COMMENTS: SITE IS LOCATED IN CENTER OF CITY                                            DIFF. GMT: WEST 05 HOURS
           ACTIVE 1/06
  ------------------------------------------------------------------------------------------------------------------------
  YEAR-QUARTER -POLLUTANT
        POLLUTANT-METHOD CODE        NUM     MIN                    PERCENTILES                  2ND    1ST    ARITH     GEOMETRIC
         METHOD                      OBS     OBS     10     30     50     70     90     95    MAX    MAX     AVG    MEAN   STD DEV
          INTERVAL AND UNITS
  ------------------------------------------------------------------------------------------------------------------------
   74-04  PARTICULATE
        1110191                       14     30.    31.    41.    63.   709.  1019.  1072.  1019.  1072.   288.    125.74    3.89
         HI-VOL  GRAVIMETRIC
          24-HOUR    UG/CU METER (25 C)

   73-04  SULFUR DIOXIDE
        4240191                       10      3.     2.    10.    10.    13.    14.    26.    16.    26.    12.     10.22    1.92
         GAS BUBBLER  PARAROSANILINE-SULFAMIC ACID
          24-HOUR    UG/CU METER (25 C)

   74-01  SULFUR DIOXIDE
        4240191                       13      3.     5.    16.    26.    34.    37.    79.    37.    79.    27.     19.80    2.47
         GAS BUBBLER  PARAROSANILINE-SULFAMIC ACID
          24-HOUR    UG/CU METER (25 C)

   74-02  SULFUR DIOXIDE
        4240191                       10      3.     2.    13.    13.    13.    65.    65.    65.    65.    25.     17.20    2.65
         GAS BUBBLER  PARAROSANILINE-SULFAMIC ACID
          24-HOUR    UG/CU METER (25 C)

   74-03  SULFUR DIOXIDE
        4240191                        8     13.    13.    13.    13.    20.    39.    39.    26.    39.    20.     17.67    1.56
         GAS BUBBLER  PARAROSANILINE-SULFAMIC ACID
          24-HOUR    UG/CU METER (25 C)

   74-04  SULFUR DIOXIDE
        4240191                       16     13.    13.    13.    13.    26.    39.    45.    39.    45.    21.     13.70    1.61
         GAS BUBBLER  PARAROSANILINE-SULFAMIC ACID
          24-HOUR    UG/CU METER (25 C)

   73-04  NITROGEN DIOXIDE
        4260291                       15      8.    11.    13.    17.    24.    38.    43.    38.    43.    22.     19.45    1.76
         UNACCEPTABLE  METHOD
          24-HOUR    UG/CU METER (25 C)
```

E-2

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07-28-75                                   NATIONAL AEROMETRIC DATA BANK
                                          QUARTERLY FREQUENCY DISTRIBUTION
                                             STATE (15): INDIANA

SITECODE: 150380001              LOCATION: BLOOMINGTON                                              LATITUDE: 39 D. 10 M. 05 S. N
AGENCY/PROJECT: F01              COUNTY (2960): MONROE CO                                           LONGITUDE: 086 D. 32 M. 10 S. W
AGENCY TYPE: STATE               SITE ADDR: CNTRL FIRE STA OLD CITY HALL 4TH & WALNUT               UTM ZONE: 16
CITY POPULATION:     42,890      STATION TYPE (13): CENTER CITY - COMMERCIAL                        UTM NORTHING: 4330310
AQCP POPULATION:    547,365      AQCR (083): SOUTHERN INDIANA                                       UTM EASTING:    540075
EPA-REGION: 5                    SMSA (0000):                                                       ELEVATION ABOVE GROUND: 060 FT.
SUPPORTING AGENCY: INDIANA AIR POLLUTION CONTROL BOARD                                              ELEVATION ABOVE MSL: 0860 FT.
COMMENTS: SITE IS LOCATED IN CENTER OF CITY                                                         DIFF. GMT: WEST 05 HOURS
          ACTIVE 1/66
------------------------------------------------------------------------------------------------------------------------------
YEAR-QUARTER  POLLUTANT
      POLLUTANT-METHOD CODE            NUM     MIN                   PERCENTILES                  2ND     1ST    ARITH     GEOMETRIC
       METHOD                          OBS     OBS     10     30     50     70     90     95     MAX     MAX     AVG    MEAN   STD DEV
        INTERVAL AND UNITS
------------------------------------------------------------------------------------------------------------------------------

 73-04  NITROGEN DIOXIDE
      4260214                          15      3.     11.    13.    17.    34.    73.    43.    33.     47.     22.    19.45    1.76
        GAS BUBBLER  NASN SODIUM ARSENITE - FRIT
         24-HOUR    UG/CU METER (25 C)

 74-01  NITROGEN DIOXIDE
      4260214                          14      4.      3.    13.    24.    41.    49.    55.    49.     55.     29.    22.32    2.40
        GAS BUBBLER  NASN SODIUM ARSENITE - FRIT
         24-HOUR    UG/CU METER (25 C)

 74-01  NITROGEN DIOXIDE
      4260211                           5      4.      3.    24.    30.    49.    55.    55.    43.     55.
        UNACCEPTABLE  METHOD
         24-HOUR    UG/CU METER (25 C)

 74-02  NITROGEN DIOXIDE
      4260214                           3      3.      3.    23.    24.    26.    62.    62.    30.     62.     27.    23.85    1.72
        GAS BUBBLER  NASN SODIUM ARSENITE - FRIT
         24-HOUR    UG/CU METER (25 C)

 74-03  NITROGEN DIOXIDE
      4260214                          13     11.     17.    23.    38.    47.    49.    56.    49.     56.     36.    32.65    1.59
        GAS BUBBLER  NASN SODIUM ARSENITE - FRIT
         24-HOUR    UG/CU METER (25 C)

 74-04  NITROGEN DIOXIDE
      4260214                          10     26.     32.    34.    41.    43.    53.    58.    53.     58.     42.    40.76    1.25
        GAS BUBBLER  NASN SODIUM ARSENITE - FRIT
         24-HOUR    UG/CU METER (25 C)
```

E-3

Ambient Air Quality Standards

	Primary	Secondary
TSP (µg/m^3)		
Annual geo. mean	75	60
Max. 24-hr conc.**	260	150
SO_2 (µg/m^3)		
Annual arith. aver.	80 (.03 ppm)	-
Max. 24-hr conc.**	365 (.14 ppm)	-
Max. 3-hr conc.**	-	1300 (0.5 ppm)
CO (mg/m^3)		
Max. 8-hr conc.**	10 (9 ppm)	10
Max. 1-hr conc.**	40 (35 ppm)	40
O_3 (µg/m^3)		
Max. 1-hr conc.**	160 (.08 ppm)	160
HC (µg/m^3)		
Max. 3-hr conc.**	160 (.24 ppm)	160
NO_x (µg/m^3)		
ANNUAL ARITH. AVER.	100 (.05 ppm)	100

**Not to be exceeded more than once a year.

Source of data: 36 F.R. 8187, April 30, 1971;
38 F.R. 25678, Sept. 14, 1973.

APPENDIX F
ENGINEERING & COST CALCULATIONS

I. TASK 2 EVALUATION OF PURE OXYGEN PROCESS

A. Two Stage Aeration (Air)

Design Flow = 16 MGD

Assume Detention Time 4 hours

Assume three parallel reactors

Reactor Flow = 16 MGD/3 = 5.33 MGD

Reactor Volume = $\frac{5.33 \times 10^6 \text{ gals}}{24 \text{ hours}} \times 4$ hours

= 8.85×10^5 gals per reactor

$\frac{8.85 \times 10^5 \text{ gal}}{7.48 \text{ gals/ft}^3} = 1.18 \times 10^5 \text{ ft}^3$ per reactor

Assume liquid depth of 15 ft

$118 \times 10^3 \text{ ft}^3/15 = 7.8 \times 10^3 \text{ ft}^2 = 78 \times 10^2$

Use 90 x 90 x 15 SWD @ 3 each

Volume supplied - $90 \times 90 \times 15 = 122 \times 10^3$

$1.22 \times 10^5 > 1.18 \times 10^5$ O.K.

Air Required for First Stage

Lbs. of BOD = 16 x 8.34 x (144-5) = 18,600# BOD

Lbs. of BOD/Tank = 18,600/3 = 6,200 # BOD

Air Requirements = 1,500 c$\overset{f}{/}$air/lb of BOD
(includes 50% safety factor)

Total Blower Capacity = 1,500 cf/air x 18,600

= $2.8 \text{ cf} \times 10^7/1.44 \times 10^3$

= 2×10^4 cfm of air

Return Sludge Pumps

Assume Aerator Vss = 3,000 mg/l

Assume Return Sludge Vss = 10,000 mg/l

3,000 (Q + Qr) = 10,000 (Qr)

3,000 Q = 7,000 Qr

Qr/Q = 3/7 = .43

Oxygen Requirement for Salt and Clear Creek; calculate O_2 requirement by the following equation.

Lbs. O_2/day = 1.5 BOD + 4.6 NH_3-N

Assume carbonacious demand (1.5 BOD) is negligible.

Salt Creek

Winter - No requirement
Summer - 3 mg/l

(12-3) x 8.34 x 16 x 1.5 = 1,800 lbs. of NH_3-N

Lbs. of O_2 = 4.6 x 1,800 = 8,300 lbs. O_2/day

Clear Creek

Winter - 6.5 mg/l
Summer - 1.5 mg/l

Winter (12-6.5) x 8.34 x 16 x 1.5 = 1,100 lbs. of NH_3-N

Summer (12-1.5) x 8.34 x 16 x 1.5 = 2,100 lbs. of NH_3-N

Lbs. of O_2 Winter 4.6 x 1,100 = 5,100 lbs. O_2/day
Summer 4.6 x 2,100 = 9,700 lbs. O_2/day

Volume for Second Stage

Source of Design Data: "Nitrification and Denitrification Facilities" EPA Technology Transfer Seminar Publication.

Assume

$Q = 16$ MGD
NH_3-N concentration = 12 mg/1
MLVss = 1,500 mg/1
Minimum operating temperature = 10°C
Operating pH = 7.8

Effluent requirements

Salt Creek - 7.9 mg/1 summer
N/A winter

Clear Creek - 3.0 mg/1 winter
1.5 mg/1 summer

It is to be noted that effluent requirements will affect operating costs (amount of air required) rather than capital costs (size of tanks).

NH_3-N Load

Maximum

Salt Creek

$$1.5 \times 16 \times 8.34 \times (12 - 7.9) = 1{,}100 \text{ lbs/day}$$

Maximum

Clear Creek

$$1.5 \times 16 \times 8.34 \times (12 - 1.5) =$$

2,250 lbs/day

Tank Volume

From Figure II-3, page 24
Volumetric Load = 8.2 lbs/1,000 ft^3

Clear Creek
$2{,}250/8.2/1{,}000 = 275{,}000\ ft^3$

Salt Creek
$1{,}100/8.2/1{,}000 = 134{,}000\ ft^3$

Tank Volume Adjusted to pH 7.8

Correction factor according to Figure III-4, page 23 = 0.88

Salt Creek

134,000/.88 = 153,000 ft^3

Clear Creek

327,000/.88 = 315,000 ft^3

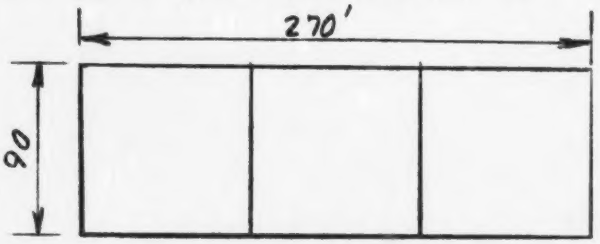
Detention Time

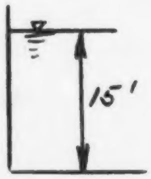
315,000 x 24 x 7.48/16 x 10^6 = 3.6 hours   Clear Creek
153,000 x 24 x 7.48/16 x 10^6 = 1.8 hours   Salt Creek

Therefore, assume the detention time is 4 hours on Clear Creek and 2 hours on Salt Creek for nitrification.

Estimate Concrete (Two Stage - Air)

90 x 90 x 17 (2 ft of freeboard)





Assume Thickness - Bottom Slab	1.25'	
Walls	1'	

Concrete	Slab - 1.25 x 270 x 90/27 =	1,110 yds
	Walls - 4 x 1 x 90 x 17/27 =	230
	Walls - 2 x 270 x 17 x 1/27 =	340
		1,680 yds

Rock = 10' x 90 x 270/27 =	9,000
Excavation = 5' x 270 x 90/27	4,500

1/2 bh

1/2 5 x 90 x 2 + 1/2 x 2 x 5 x 270

$\frac{450}{27} + \frac{1350}{27}$ 100

4600

Construction Cost

Concrete	1,680 x 400	672,000
Rock	9,000 x 10	90,000
Excavation	4,600 x 4	18,000
		780,000

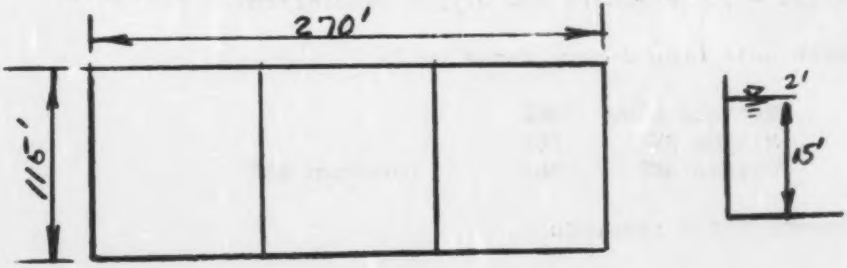
Two Stage	2 x 780,000	1,560,000

Concrete, Rock, Excavation	1,560,000
Equipment	390,000
Install	80,000
	$2,030,000

Project Cost	2,639,000
Project Cost @ 15 MGD	2,474,000
Salvage Value = 1,560 x 1.30 x 30/50 =	1,216,000
Salvage Value @ 15 MGD	1,140,000

B. Single Stage Aeration (Air)

Detention Time = 6 hrs



Concrete

Slab	- 270 x 115 x 1.25 x/27	1,420
Walls	- 4 x 1 x 115 x 17/27	300
Walls	- 2 x 270 x 17 x 1/27	340
		3,020

Excavation

10 x 115 x 270/27	11,560

Excavation

5' x 270 x 115/27	5,750
1/2 x 2 x 5 x 115 + 1/2 x 2 x 5 x 270	100
	5,850

Construction Cost

Concrete	2,060 x 400	824,000
Excavation	17,300 x 4	70,000
Equipment		310,000
Install		62,000
		1,266,000

Project @ 15 MGD $1,645,000

Salvage Value

1.30 x 10/30 (824,000 + 108,400) = 811,000

C. Two Stage, Aeration - Oxygen System

The following parameters were given by oxygen manufacturers.

Detention Time - 1-1/2 hours for first stage
1-1/2 hours second stage

MLSS - 4,500 mg/1

Depth of reactor 13 deep

Allow 4 ft freeboard for oxygen absorbtion.

Each unit should have three cells

Recycle Flow	30%	
Mixing BHP	261	
Oxygen BHP	365	Turndown 60%

Assume three reactors

Q/reactor = 5.33 MGD
Liquid Depth = 13 deep
Detention Time = 1.5 hours

Volume req'd = 5.33×10^6 gal/day x 1 day/2.4 x 10' hrs x 1.5 hours

= 3.33×10^5 gallons

33.3×10^4 gals/7.48 gals/ft^3 = 4.45×10^4 ft^3

Surface Area = 44.5×10^3 ft^3/13 ft

3.423×10^3 ft^2

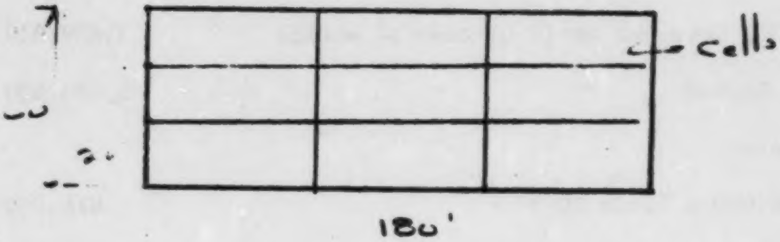
3423 ft^2

Use 60 x 60 x 13 SWD Basins

Volume Supplies

60 x 60 x 13 = 46,800 ft^3

46,800 > 44,500 O.K.



Concrete

Bottom Slab	1.25 x 180 x 60/27 =	500
Walls	4 x 1 x 180 x 17/27 =	450
Walls	4 x 60 x 1 x 17/27 =	150
		1,100
Top Slab	1/2 x 180 x 60/27 =	200
Rock	8' x 180' x 60'/27 =	3,200 yds
Earth	5 x 180 x 60/27 =	2,300 yds
	2 x 1/2 x 5 x 5 x 180/27	200
	2 x 1/2 x 5 x 5 x 60/27	50
		2,550 yds

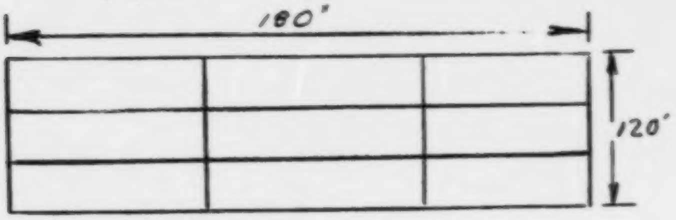
Construction Cost

Concrete	1,100 x 400	440,000
	200 x 200	40,000
Rock	3,200 x 10	32,000
Earth	2,550 x 4	10,000
		$522,000

Two stage will require 2 x 522,000	1,044,000
Concrete, Rock, Excavation	1,044,000
Equipment	1,900,000
Install	80,000
	$3,024,000
Project (30% does not apply because of equip)	3,639,000
Project @ 15 MGD	3,420,000

Salvage Value

1,044,000 x 1.3 x 30/50 =	814,000
@ 15 MGD	765,000



D. Single Stage Oxygen System

Concrete		
Bottom Slab	1.25 x 180 x 120/27	1,000
Walls	4 x 1 x 180 x 17/27	450
Walls	4 x 1 x 120 x 17/27	300
		1,750
Earth		
	8' x 120 x 180/27	6,400
Earth		
	5 x 120 x 180/27	4,600
	2 x 1/2 x 5 x 5 x 180/27	200
	2 x 1/2 x 5 x 5 x 120/27	110
		11,300

Concrete	1,750 x 400	700,000
Earth	11,300 x 4	45,000
Equipment		1,900,000
Install		80,000
		2,725,000
Project Cost		3,260,000
Project Cost @ 15 MGD		3,064,000

Salvage Value

1.3 x 30/50 (700,000 + 45,000) = 581,000

@ 15 MGD 546,000

E. Clarifiers for Air & Oxygen Systems

Size Air Clarifiers

Assume 3 units

Overflow rate - 700 gals/ft^2/day

Solids Loading - 25 lbs/ft^2/day

Q clarifier = 16/3 = 5.33 MGD

Area Req'd = 53.3 x 10^5/7 x 10^2 = 7,650 ft^2

Use 100 ft dia. units

7,850 ft^2 > 7,650 O.K.

Check Solids Loading

Lbs. to Clarifier = 3,000 x 8.34 x 5.33 (1t. 43)

3,000 x 8.34 x 7.6

191,000 lbs/day/reactor

191,000/25 lbs/ft^2/day = 7,650 ft^2

7,850 ft^2 > 7,650 O.K.

Assume 12 deep clarifiers

7,850 x 12 = 94,000 ft^3

94,000 ft^3 x 7.48 $gals/ft^3$ = 705,000 gals.

$$\frac{705{,}000 \text{ gals.}}{5{,}330{,}000 \text{ gals/day}} = 131 \text{ days} = 3.1 \text{ hours O.K.}$$

Size Oxygen Clarifiers

Assume 3 units

Overflow Rate = 550 gal/ft^2 (oxygen mfs received)

Solids Loading 25 $lbs/ft^2/day$

Area Req'd $5.33 \times 10^5 / 5.5 \times 10^2$ = 9,750 ft^2

Check Solids Loading

Q recycle = 30%
MLSS = 4,500 mg/l

# 4,500 x 8.34 x 5.33 (1 + .3) = 260,000#

Area Req'd = 260,000/25 = 10,400 ft^2 req'd

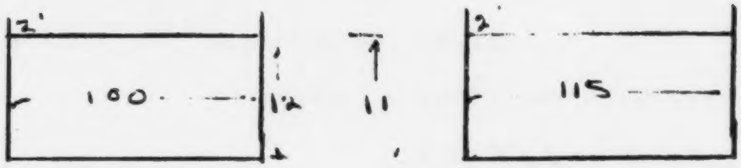
10,400 > 9,750 solids loading governs

Use 115 ϕ unit = 10,400 ft^2

10,400 = 10,400 O.K.

Depth 11 ft (supplied by oxygen mfs)

Construction Costs



Concrete Slab	$1.25/27 \times .785 \times 100^2$	
	$1.25/27 \times 7{,}850 = 330$ yds	$1.25/27 \times 10{,}400 = 470$
Walls	$14/27 \times .798\ (101^2 - 100^2)$ $14/27\ .875 \times 201 = 80$ yds	$13/27 \times .785\ (116^2 - 115^2)$ $13/27 \times .785 \times 231 = 90$
	330 + 80 = 410/each	470 + 90 = 560/each

Rock (assume 5 deep)

7'/27 x 7,850 = 2,000 yds/ea.	6'/27 x 10,400 = 2,400 yds/ea.

Excavation

5/27 x 7,850 = 1,400 yds/ea.	5/27 x 10,400 = 2,000/ea.

Clarifier Mechanisms & Weirs & Baffles

100' ϕ	$52,000/each
115' ϕ	$71,000/each

Source - Envirex phone call.

Area Required

	Air	Oxygen
Single Nitrification	3 x 7,850 = 23,000	3 x 10,400 = 31,200
Dual Nitrification	47,000	62,400

Air - Single Stage

Concrete	3 x 410 yd x $400/yd =	492,000
Rock	3 x 2,000 yd x $10 day	60,000
Earth	3 x 1,400 yd x $4/yd	16,800
		568,000
Equipment	52,000 x 3	156,000
Install	156,000 x .2	31,200

Installation cost assumes 20% of equipment price.

Oxygen - Single Stage

Concrete	3 x 560 x 400	672,000
Rock	3 x 2400 x 10	72,100
Earth	3 x 2000 x 4	24,000
		768,100
Equipment	71,000 x 3	213,000
Install	213,000 x .2	42,600
		255,600

	Air		Oxygen	
	1 stg	2 stg	1 stg	2 stg
Equipment	156,000		213,000	
Inst.	31,000		42,600	
Concrete	492,000		672,000	
Rock	60,000		72,100	
Earth	16,000		24,000	
	756,000		1,024,000	
30% Project	982,000	+ 1,965,000	1,332,000	+ 2,662,000
@ 15 MGD	923,000	1,847,000	1,252,000	2,502,000
Salvage Value	(982,000 - 187,000) 30/50		(1,332,000 - 256,000) 30/50	
	477,000		645,000	
@ 15 MGD	448,000	896,000	606,000	1,212,000

F. Clarifier System - Air & Oxygen - 16 MGD O&M Costs

	Air		Oxygen	
Single				
Man-Hours	2,600 x 6 =	$15,600	3,200 x 6 =	$19,200
Materials Supply	$29,000 x 171/112	45,000	38,000 x 171/112	58,000
		$60,600		$77,200
@ 15 MGD		56,900		72,600
Dual				
Man-Hours	3,200 x 6 =	$19,200	4,800 x 6 =	$ 29,000
Materials Supply	$50,000 x 171/112	36,000	63,000 x 171/112	97,000
		$95,200		$126,000
@ 15 MGD		89,500		118,400

Source: Fig. 30 - Estimation Costs

Assume all clarifiers work from startup to finish.

G. Aeration System - Air - Operation & Maintenance Costs

	AIR			
	One Stage		Two Stage	
Man-hours	11	16	11	16
Operation (hrs)	1,900	1,200	2,700	2,000
Maintenance (hrs)	1,100	2,100	1,700	3,200
	3,000 x 6	3,330 x $6/hr	4,400 x 6	5,200 x $6/hr
	18,600	19,800	26,400	31,400
Materials & Other Supplies	$ 3,000	$10,700	$ 3,000	$10,700
TOTAL	$21,000	$30,500	$29,400	$42,100
@ 15 MGD		$28,700		$39,500

Materials & Other Supplies 171/112 = 1.53

1.53 x 7,000 = 10,700
1.53 x 2,000 = 3,000

H. Aeration System - Oxygen - Operation & Maintenance Costs

	OXYGEN			
	One Stage		Two Stage	
Man-hours	11	16	11	16
Operation	$ 2,000	$ 2,100	$ 2,800	$ 3,500
Maintenance	1,200	1,500	1,700	2,000
	3,200 x 6	3,600 x $6	4,500 x 6	5,500 x $6
	$19,200	$21,600	$27,000	$33,000
Materials	3,000	10,700	3,000	10,700
	$22,200	$32,300	$30,000	$43,700
@ 15 MGD		$30,400		$41,100

I. Return Sludge Pumping Costs

GPM x HEAD x SP. GR/3,960 x EFF. = B.H.P.

16 x .43 = 6.88 HGD 30'

694 (6.88) (30) (1)/3,960 x .75 = 48.2 hp

@ 95% Motor Eff = 50.8 hp

50.8 x 24 hr x 365 x .0149 $/hp hr = $6,630/yr

@ 15 MGD $6,232

16 x .30 = 4.88 20'

694 x (4.8) (20) (1)/3,960 x .75 = 22.4 hp

@ 95% Motor Eff = 23.6 hp

23.6 x 24 x 365 x .0149 = $3,080/yr

@ 15 MGD $2,895/yr

J. Air & Oxygen Power Costs

The following data were supplied by manufactuers of oxygen systems and air systems. The air systems were based on a submersed tubing with 30% efficiency.

The following data was supplied by manufacturers and pertains to oxygen systems.

Salt Creek

16 MGD

Winter
414 x 24 x .0149 x 270 = 39,972

Summer
594 x 24 x .0149 x 90 = 19,117
$59,089

@ 15 MGD 55,543

11 MGD

Winter
289 x 24 x .0149 x 270 = 27,903

Summer
415 x 24 x .0149 x 90 = 13,356
41,259

Clear Creek

Oxygen

16 MGD

Winter
520 x .0149 x 24 x 270 = 50,205

Summer
626 x .0149 x 24 x 90 = 20,147
70,352

@ 15 MGD 66,130

11 MGD

Winter
364 x .0149 x 24 x 270 = 35,144

Summer
438 x .0149 x 24 x 90 = 14,096
$49,240

The following data was supplied by manufacturers and pertain to Air systems.

Clear Creek

15 MGD

Winter
485 BHP x 24 x .0149 x 270 = $46,831

Summer
317 BHP x 24 x .0149 x 90 = 16,536
$63,367

11 MGD

Winter

361 BHP x 24 x .0149 x 270 = $34,855

Summer

380 BHP x 24 x .0149 x 90 = 12,229

$47,184

Salt Creek

Air

15 MGD

Winter

342 x 24 x .0149 x 270 = $32,947

Summer

516 x 24 x .0149 x 90 = 13,668

$46,615

11 MGD

Winter

254 x 24 x .0149 x 270 = $24,698

Summer

317 x 24 x .0149 x 90 = 10,202

$34,890

K. Present Worth Comparison of Air & Oxygen at Clear Creek

Operating Costs

	Air		Oxygen	
	11	15	11	15
Clarifier	63,784	89,500	84,420	118,400
Aeration	47,184	63,367	45,240	66,130
	29,400	39,500	30,000	41,100
Return Sludge	9,140	12,464	4,246	5,790
	149,508	204,831	167,894	231,420

(204,831 - 149,508)/20 = 53,323/20

= 2,766

(231,420 - 167,894)/20 =

3,176

Present Worth of Constant O & M

Air	Oxygen
11.47 x 149,508 = 1,715,000	11.47 x 167,854 = 1,925,744

Present Worth of Variable O & M

86.01 x 2.766 = 238,000   86.01 x 3176 = 273,167

Initial Project Cost

	Air	Oxygen
Aerators	2,474,000	3,420,000
Clarifiers	1,847,000	2,502,000
Add	500,000	500,000
	4,821,000	6,422,000

Present Work of S.V.

Aerators	1,140,000	765,000
Clarifiers	876,000	1,212,000
Add	300,000	900,000
	2,336,000	2,277,000
	714,000	696,000

Initial Cost	4,821,000	6,422,000
P.W. of O&M	1,715,000	1,926,000
P.W. of O&M	238,000	273,000
	6,774,000	8,621,000
S.V.	714,000	696,000
	$6,060,000	$7,925,000

L. Present Worth Comparison of Air and Oxygen at Salt Creek

Operating Costs

	Air		Oxygen	
	11	15	11	15
Clarifier	41,662	56,900	53,268	72,600
Aerator	34,890	46,615	41,255	55,543
	21,000	28,700	22,200	30,400
Return Sled	4,570	6,232	2,123	2,895
	102,122	138,447	118,850	161,438

(138,447 - 102,620)/20 = 1816   161,438 - 118,850 = 2129

Present Worth of Constant O & M

Air	Oxygen
11.47 x 102,120 = 1,171,000	11.47 x 118,852 = 1,313,232

Present Worth of Variable O & M

86.01 x 1816 = 156,000	86.01 x 2,129 = 183,115

Initial Project Cost

	Air	Oxygen
Aerators	1,645,000	3,064,000
Clarifiers	923,000	1,252,000
	2,568,000	4,316,000

Present Worth of S.V.

Aerators	542,000	546,000
Clarifier	448,000	606,000
.3058	990,000	1,152,000
	303,000	352,000
Initial Cost	2,508,000	4,316,000
P.W. of Con. O&M	1,189,000	1,363,000
P.W. of Var. O&M	159,000	183,000
	3,916,000	5,862,000
S.V.	303,000	352,000
	3,613,000	5,510,000

Assume oxygen system will eliminate sludge thickening device.

Construction Cost = $210,000
Project Cost = $274,000

Assume Equipment Cost = $30,000

S.V. = (274,000 - 30,000)30/50

146,000

O & M @ 15 MGD = $ 28,000
@ 11 MGD = 20,600
7,200/20 = 360

P.W. of Constant O & M = 20,600 x 11,470 = 236,287
P.W. of Variable O & M = 360 x 86.01 = 30,963

P.W. of S.V. = 1,146,000 x .3058 = 44,000

Project Cost	274,000
P.W. of O & M	236,000
	31,000
	541,000
S.V.	44,000
	497,000

II. PRESENT WORTH ANALYSIS - SOUTH BLOOMINGTON

A. Site Development

Winston Thomas

1. 3200 feet of stream relocation
   (Assume 5' deep)

2. Flood elevation 675'
   Length 3800'

South Rogers

1. Relocate Trailer Park
   Assume $500,000

2. Relocate streams
   1300 feet and 3200 feet. Assume 5' deep

3. Levee Elevation
   Upper 676 and lower 672

   Length of Dike = 2500
   Depth

Dillman Road

1. Levee

2. Stream Relocation

2000 Feet. Assume 10' deep cut.

Salt Creek

Stream Recollection 1000'

Assume 10' deep

Ketcham Rd

1. Levee

Length - 2200'

2. Relocate stream

2500 ft. Assume 10' deep

Salt Creek

Salt Creek Flood Elevation - 512

Assume grade is 505 and top of levee 515

L = 3400 feet

CONSTRUCTION COSTS

Winston Thomas

Stream relocation

Volume = 3200 x [20 x 5 + 2 x 1/2 x 5 x 2]/27
3200 x [100 + 10]/27

13,037 yd x $10/yd = $130,000

Rip Rap 2 x 3200/9 x (5.4/2) = 1920 sq.yd.

1920 sq. yds x $20/yd. = $38,000

Stream Fill = 5 x 1600 x 20/27 x $1/yd = $6000

Dike

Volume = 3800/27 [10 x 10 + 1/2 x 10 x 10 x 2]
= 28,148

28,148 x $15/yd = $422,000

Stream Fill	6,000
Stream Relocation	130,000
Rip Rap	38,000
Levee	422,000
Construction Cost	596,000
30%	179,000
Total	$775,000

South Rogers

Stream Relocation

Volume = (1300 + 3200) [20 x 5 + 2 x 1/2 x 5 x 2]/27
4500 [100 + 10]/27 = 18,333
18,333 x 10 = $183,000

Rip Rap = 2 x 4500/9 x 5.4/2 = 2700

Stream Fill = 2700 x $20 = $54,000
1500/27 x 20 x 5 x $1/yd = $6,000

Dike

Volume - 4500/27 [100 = 100] = 33,333 yds.

Land - 33,333 x $15/yd	$500,000
40 acres x 2500	100,000
Stream Fill	60,000
Land	100,000
Trailer Park Relocation	500,000
Dike	500,000
Stream Relocation	183,000
Rip Rap	54,000
Construction	$1,343,000
Project Cost (30%)	$1,745,000

S.V. = 100,000
P.W.S.V. = 30,000

Ketcham Rd.

Stream Relocation

Volume = 2500 [20 x 10 +]/2 x 4 x]0 x 2]/27
92.6 [200 + 40]
21,574 yd.
21,574 x 10 = $216,000

Rip Rap 2 x 2500/9 (10.5/2) = 2516
2516 x 20 = $58,000

Stream = 1800/27 x 20 x 5 x $1/yd. = $7,000

Dike

2200/27 (10 x 10 x 1/2 x 2 x 10 x 10) + 900/27 (10 x 5 x 1/2 x 2 x 5 x 10)
16,296 + 3,333
19,625 x $15/yd. = $294,440

Land - 60 acres x 2,500 = $150,000

Land	
Stream Fill	7,000
Stream	216,000
	58,000
Dike	295,000
Land	150,000
	$726,000
Project	$943,000

P.W.S.V = $45,000

Dillman Site

Land - 60 acres x 2500 = $150,000

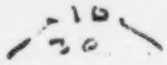
Stream Relocation

Volume = 2000/27 [20 x 10 + 1/2 x 2 x 10 x 4]
74 (200 + 40)
17,777 yds.
17,777 x 10 = $178,000

Rip Rap = 2000 x 2/9 x 10.5 = 4667
4667 x $20 = $94,000

Stream Fill = 3000/2 x 20 x 5 x $1/yd = 12,000

Dike



Volume = 1500/27 (10 x 10 + 1/2 x 2 x 10 x 10)
40.74 x 200
11,111 x $15/yd. = $167,000

Land	150,000
Stream Fill	12,000
Stream Relocation	178,000
Rip Rap	94,000
Dike	167,000
	601,000
Project Cost	$781,000

P.W.S.V. = 45,000

Salt Creek

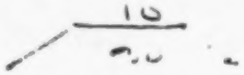
Stream Relocation

1000/27 (20 x 10 + 2 x 1/2 x 10 x 4)
8888 yds. x $10 day = $89,000

Rip Rap = 1000 x 2/9 [105 x $20/yd] = $47,000

Stream Fill = $1/yd x 10/27 x 20 x 2100 = $16,000

Dike



Volume = 3400/27 (10 x 10 + 1/2 x 2 x 10 x 10)
125.93 x 200 = 25,185
25,185 x 15 = $378,000

Land = 160 x 2,500 = $150,000

Stream Relocation	89,000
Rip Rap	47,000
Stream Fill	16,000
Dike	378,000
Land	150,000
	$680,000
Project Costs	$884,000

S.V. = 45,000

		P.W.
Winston Thomas -		$ 775,000
South Rodgers -	1,745,000 - 30,000	$1,715,000
Ketcham -	943,000 - 45,000	$ 898,000
Dillman -	781,000 - 45,000	$ 736,000
Salt Creek -	884,000 - 45,000	$ 839,000
Salt Creek (extra land) -		$ 455,000

B. Calculated Cost of Treatment Plant

Items Required

1. Preliminary Treatment

    a. Grit removal equipment
    b. Pumps
    c. Pump station building

Q_{avg} = 16 MGD

Q_{max} = 32 MGD

Construction Cost = $700,000 (1971)
Construction Cost = 7000,000 x 232/151 = $1,075,000 (1975)
Project Cost = 1,075,000 x 1.3 = 1,398,000

2. Administration Building

    a. Clerical
    b. Laboratory

Construction Cost = $150,000 (1971)
150,000 x 1.54 = 230,000 (1975)
Project Cost = 1.3 x 230,000 = $300,000

3. Garage & Shop Facilities

Construction Cost = $45,000 (1971)
Construction Cost = $45,000 x 1.54 = $70,000
Project Cost = $70,000 x 1.3 = $90,000

4. Chlorine Building and Equipment

$32 \times 8.34 \times 8 = 2135$ lbs/day

Construction Cost = \$110,000
Construction Cost = \$110,000 x 1.54 = \$170,000
Project Cost = \$170,000 x 1.3 = \$220,000

5. Chlorine Contact Basins

$$32 \times 10^6 \frac{\text{gals}}{\text{day}} \times \frac{\text{day}}{24 \text{ hour}} \times 15 \text{ min.} \times \frac{1 \text{ hour}}{60 \text{ min}} =$$

$$\frac{.33 \times 10^6 \text{ gals}}{7.48 \text{ gals/ft}^3} = 33 \times 10^4/7.48 = 44{,}100 \text{ ft}^3$$

Construction Cost = \$700,000
Construction Cost = \$700,000 x 1.54 = \$1,078,000
Project Cost = \$1,401,000

6. Return Activated Sludge Pumping

Use Q = 16 MGD
Install = 32 MGD Use thru pumps
@ 11 MGD
Firm capacity = 22 MGD

Construction Cost = \$250,000
Construction Cost = \$250,000 x 1.54 = \$385,000
Project Cost = \$385,000 x 1.3 = \$500,000

7. Pumping to Filtration Units

Use 22 MGD
Project Cost = \$500,000

8. Filtration Units

Use 2.5 gpm/ft^2

$$16 \times 10^6 \text{ gals/day} \times \frac{1 \text{ day}}{1.440 \text{ min}} = 11.11 \times 10^3 \text{ gpm}$$

$$11.11 \times 10^3/2.5 \text{ gpm/ft}^2 = 4{,}480 \text{ ft}^2$$

Construction Cost = \$900,000
Construction Cost = 232/175 x 900,000
= 1,200,000
Project Cost = \$1,550,000

Source EPA Suspended Solids Removal

9. O & M

Manhours

$N = gQ^h$

$N = 460 \times 16^{.80}$ $460 \times 5.2 = 4232$ hours

$N = 460 \times 11^{.80}$ $460 \times 6.8 = 3128$

Materials & Supply

$S = i\ (FQ)^J$ $i = 17.40;\ j = .8$

$F = 1.0;\quad Q = 16$

at 16 MGD

$17.40 \times 16^{.8} = 17.4 \times 9 =$ \$150,000

at 11 MGD

$17.4 \times 11^{.8} = 17.4 \times 6.8 =$ \$120,000

10. Equilization Basin

Basin size required = 10 Mg

Basin size - 2.4 MG Costs = \$595,000

$$\frac{595{,}000}{\left(\frac{2.4}{10}\right)} = 595{,}000/.36$$

\$1,700,000 x 232/175 = \$2,253,000

Source: Flow Equilization EPA Bulletin

11. HVAC, Plumbing & Electrical Work

Assume 25% of other work costs

.25 x 11.942,000 = 3,000,000

12. Yard Work

Assume 20% of other construction costs from EPA Bulletin

.20 x 14,942,000 = 2,988,000

Use \$3,000,000

Summary of Costs - Project Costs

Preliminary Treatment	$ 1,398,000
Administration Building	300,000
Garage & Shop	90,000
Chlorine Bldg.	220,000
Chlorine Contact Basin	1,078,000
Return Sludge Pumping	500,000
Pumping to Filtration Units	500,000
Filters	1,550,000
Electric Substation	750,000
Pond	2,253,000
Aeration & Clarifiers	2,566,000
Electrical, HVAC, Plumbing	3,000,000
Yard Work	3,000,000
Project Cost	$17,205,000
@ 15 MGD	16,130,000

C. Calculate O & M Costs

Wastewater pumping	11		16
Labor	1500 hrs. $ 9000		2000 hrs. $12,000
Electricity	10,000		20,000
Material & Supply (1800 x 1.53)	3,000	(2800 x)	4,500
	$22,000		$36,500

Use above figures for pumping to filters

Preliminary Treatment	11	16
Labor	3600	4800
	$22,000	$29,000
Material & Supply	4,500	6,000
	$26,500	$35,000

Chlorination	11	16
	1850	2500
Labor	$ 11,000	$ 15,000
Material	2,500	3,000
Chlorination	180,000	117,000

Yardwork	11	16
Labor	2,000	3,500
Material & Supply	3,000	4,500
	$ 15,000	$ 25,500

Laboratory	11	16
Labor	4,100	4,300
	$ 25,000	$ 26,000
Material & Supply	2,000	4,500
	$ 27,000	$ 30,500

Administration	11	16
Labor	2,800	4,500
	$ 17,000	$ 27,000
General Expense	7,000	8,000
	$ 24,000	$ 35,000

Pumping	Electric	$ 4,574	$ 6,630
	Manpower	4,500	6,000
		$ 9,074	$ 12,630

Filtration (Source: Culp, Weiser & Culp)

EPA STP Index - 200

@ 16 MGD = 180,000 x 231/200 = 208,000
@ 11 MGD = 130,000 x 231/200 = 150,000

Equalization Basin

Assume same costs at 11 MGD as 16 MGD
Assume 300 HP

Power costs	= 200 x 24 x 365 x .0145 =	26,000
Material		2,000
Manpower	= 3800 x 6	23,000
		$51,000

Summary O & M		11	16
1.	Raw & intermediate pumping	$ 44,000	$ 73,000
2.	Preliminary Treatment	27,000	35,000
3.	Chlorination	80,000	117,000
4.	Aerator Clarifiers	99,000	141,000
5.	Filtration	150,000	208,000
6.	Pumping	10,000	13,000
7.	Yardwork	15,000	26,000
8.	Laboratory	27,000	31,000
9.	Administration	24,000	35,000
10.	Equalization Basin	51,000	51,000
		$527,000	$730,000
	@ 15 MGD		684,000

P.W. and O & M

$527,000 x 11.47 = $6,045,000

P.W. = ($684,000 - $527,000)/20 x 86.01 = $675,000

= $6,720,000

III. TASK 6 - PRESENT WORTH ANALYSIS - LAKE MONROE

Smithville and Sanders at Dillman

One P.S. $Q_{avg} = .08$
6500 FM @ 4"
5500 @ 8 gravity
Head = 820 - 730 - 90 static - 80 friction

$$\text{O \& M} - \frac{.75 \times 170 \times .08 \times .0149 \times 24 \times 365}{.5} = \$700$$

Labor	6,000
	$6,700
P.W. of O & M 11.47 x 6700	77,000
P.S.	55,000
6500 @ 15	98,000
5500 @ 27	149,000
	302,000
Project Cost	393,000
S.W. = 393,000 x 31/50 x .3052 =	72,000
P.W.	393,000
	77,000
	-72,000
	$398,000

Smithville and Sanders Costs at Dillman

Smithville and Sanders require .08 MGD reserved capacity. Their proportionate share is .08/15 x 100 = .53%.

Smithville and Sanders are responsible for:

.0053 x (28,583,000 - 2,319,000) = 139,000

Smithville and Sanders (Clear Creek)

Gravity Line - 18,500 @ 8"
Construction Cost = 18,500 x $17/ft = $499,500
Project Cost = $499,500 x 1.3 = $649,000
S.W. = $649,000 x 30/50 x .305 = $118,000
P.W. = $531,000

Clear Creek Plant

Castore	500,000 - 100,000	=	$400,000
Harrodsburg			120,000
Smithville			80,000
			600,000 gpd

Assume package plant

Equipment	$500,000
Instrumentation	100,000
Building - $20/sq. ft.	100,000
	$700,000

Project Cost			$910,000
S.W.	910,000 x 6	=	546,000
P.W.S.V.	546,000 x .3058	=	166,000
P.W.	910,000 - 133,000	=	$777,000

Interceptor $Q_{avg} = .12 + .08 = .20$
Use existing interceptor for Castore

500 ft @ 8" x $27/ft.		=	$135,000
Project Cost			176,000
S.V.P.W.	= 176,000 x .6 x .3052	=	26,000
P.W.			$150,000

Land = 5 acres x \$2500 = \$13,000
S.V. = \$13,000

Clear Creek Plant Construction Cost

Plant	\$ 700,000
Int.	135,000
Land	13,000
	\$ 848,000

Project Cost = \$910,000 + \$176,000 + \$13,000 = \$1,099,000

O & M

For 1 MGD	=	\$100,000
Filtration	=	30,000
		\$130,000

Q Start-up		Q Down
Caston	.03	.5
Harrodsburg	.10	.12
Smithville	.06	.08
	.20	.70

$Cs = Cs/(Q_L/Q_s)$

$Cs = Cs/(1/.20)^{.55}$ $\qquad$ $Cs = Cs/(1/.70)^{.6}$

$Cs = C_L/(5)^{.55}$ $\qquad$ $Cs = Cs/(1.43)^{.6}$

$Cs = C_L/2.4$ $\qquad$ $Cs = Ca/1.24$

$Cs = .42\ Cs$ $\qquad$ $Cs = .81\ Cs$

O & M @ .2 = .42 x \$130,000 = \$55,000

O & M @ .7 = .81 x \$130,000 = \$105,000

Present worth

55,000 x 11.47	=	\$630,850
50,000/20 x 86.01	=	215,025
		\$845,875

Fairfax to Caslon

5000 ft @ 8" gravity
16,000 ft @ 4" F.M.
3 p.s.

O & M Pump Station

Power =	3 @ $200	$ 600
Labor		12,000
		$12,600

5000 ft @ $27/ft.	$135,000	$ 81,000
16,000 ft @ $15/ft.	240,000	240,000
P.S. + $55,000 @ 3	165,000	165,000
		$486,000
Construction Cost	$540,000	146,000
Project Cost	$702,000	$632,000

IV. TASK 6 - PRESENT WORTH ANALYSIS - INTERCEPTORS AND PUMPING STATIONS

A. Unit Prices - Interceptor Sewer

Normal Excavation - $5/c.y.

Rock Excavation - $25/c.y.

Trench Backfill - $6/c.y.

PIPE PRICES

Size	Type	Mat. & Labor	Normal Excav.*	Rock Excav.*	Backfill*	Total
24"	D.I.	$66/L.F.		$37/L.F.	$9/L.F.	$112/L.F.
30"	D.I.	71		42	10	123
42"	RCP	88		51	12	151
48"	D.I.	105		56	13	174
54"	RCP	132		60	15	207
60"	RCP	149		65	16	230
60"	RCP	149	$13/L.F.		16	178
66"	RCP	165	14		17	196
72"	RCP	187	15		18	220
78"	RCP	209	16		19	244

*Trench depth = 10'

Trench width = pipe diameter + 2 feet

B. Interceptor Systems - Construction Costs

Alternative 1 - Gravity Interceptor to Salt Creek Site

Item	Quantity	Unit Price	Total
42" RCP (rock)	10,000 L.F.	$151/L.F.	$ 1,510,000
54" RCP (rock)	7,500	207	1,550,000
60" RCP (rock)	29,000	230	6,670,000
66" RCP	6,000	196	1,180,000
72" RCP	8,500 L.F.	$220/L.F.	$ 1,870,000
78" RCP	10,000	244	2,440,000
Manholes	134	$1,500 ea.	201,000
Railroad Boring	15	L.S.	426,000
Stream Crossing	25	L.S.	365,000
Total Construction Cost			$16,212,000

Alternative 2 - Gravity Interceptor and Force Main to Salt Creek Site

Item	Quantity	Unit Price	Total
42" RCP (rock)	10,500 L.F.	$151/L.F.	$ 1,590,000
48" DIP (rock)	13,000	174	2,260,000
60" RCP (rock)	14,800	230	3,400,000
60" RCP	3,700	178	660,000
72" RCP	6,500	220	1,430,000
78" RCP	9,000	244	2,200,000
Manholes	78	$1500 ea.	120,000
Railroad Boring	2	L.S.	40,800
Steam Crossing	2	L.S.	31,900
Pump Station	1	L.S.	2,500,000
Total Construction Cost			$14,232,700

Alternative 3 - Gravity Interceptor to Ketcham Road Site

Item	Quantity	Unit Price	Total
42" RCP (rock)	9,600 L.F.	$151/L.F.	$ 1,450,000
54" RCP (rock)	8,800	207	1,820,000
60" RCP (rock)	5,000	230	1,150,000
Manholes	45	$1500 ea.	68,000
Railraod Boring	6	L.S.	151,200
Stream Crossing	5	L.S.	67,500
Total Construction Cost			$ 4,706,700

Alternative 4 - Gravity Interceptor to Dillman Road Site

Item	Quantity	Unit Price	Total
42" RCP (rock)	9,600 L.F.	$151/L.F.	$ 1,450,000
54" RCP (rock)	3,000	207	620,000
Manholes	29	$1500 ea.	44,000
Railroad Boring	2	L.S.	40,800
Stream Crossing	2	L.S.	24,200
Total Construction Cost			$ 2,179,000

Alternative 5 - Force Main to South Rogers Street Site

Item	Quantity	Unit Price	Total
24" DIP (rock)	6,000 L.F.	$112/L.F.	$ 672,000
30" DIP (rock)	9,000	123	1,107,000
Pump Station #1	1	L.S.	1,000,000
Pump Station #2	1	L.S.	1,400,000
Railroad Boring	1	L.S.	61,200
Total Construction Cost			$ 4,240,200

C. Stream Crossings

For stream crossings, use 2 x excavation and backfill prices and 1.5 x material and labor prices.

Stream crossings are 40', manhole to manhole.

Alternative 1

Size	# Crossings	L.S. Per Crossing	Total
42"	1	$ 10,320	$ 10,320
54"	3	13,920	41,760
60"	15	15,420	231,300
66"	3	12,380	37,140
72"	1	13,860	13,860
78"	2	15,340	15,340
	Total		$365,060

Alternative 2

Size	# Crossings	L.S. Per Crossing	Total
72"	1	$ 13,860	$ 13,860
78"	1	18,060	18,060
	Total		$ 31,920

Alternative 3

Size	# Crossings	L.S. Per Crossing	Total
42"	1	$ 10,320	$ 10,320
54"	3	13,920	41,760
60"	1	15,420	15,420
	Total		$ 67,500

Alternative 4

Size	# Crossings	L.S. Per Crossing	Total
42"	1	$ 10,320	$ 10,320
54"	1	13,920	13,920
	Total		$ 24,240

Alternative 5

No stream crossings.

D. Railroad Borings

Railroad borings are 80'.

Unit Prices

24" - $150/L.F.
30" - 180
42" - 230
48" - 270
54" - 300
60" - $340/L.F.
66" - 370
72" - 400
78" - 450

Excavation for boring pit - $2,000/pit.

Alternative 1

Size	# Borings	L.S. Per Boring	Total
42"	2	$ 20,400	$ 40,800
54"	2	26,000	52,000
60"	7	29,200	204,400
66"	3	31,600	94,800
72"	1	34,000	34,000
	Total		$426,000

Alternative 2

Size	# Borings	L.S. Per Boring	Total
42"	2	$ 20,400	$ 40,800

Alternative 3

Size	# Borings	L.S. Per Boring	Total
42"	2	$ 20,400	$ 40,800
54"	2	26,000	52,000
60"	2	29,200	58,400
	Total		$151,200

Alternative 4

Size	# Borings	L.S. Per Boring	Total
42"	2	$ 20,400	$ 40,800

Alternative 5

Size	# Borings	L.S. Per Boring	Total
42"	3	$ 20,400	$ 61,200

E. Pumping Stations

1. Construction Costs (based on peak flows)

Pump Station within S.T.P.

40 MGD Peak (16)

Basic cost $650,000 x 232.1/150.6 = $1,001,000
Total cost $820,000 x 1.54 = $1,263,000

16 MGD Peak (6.5)

Basic cost $300,000 x 1.54 = $462,000
Total cost $400,000 x 1.54 = $616,000

9 MGD Peak (3.5)

Basic cost $190,000 x 1.54 = $293,000
Total cost $230,000 x 1.54 = $354,000

Pump Station outside of S.T.P.

$c = 250\ Q^{.62}$ - Camp. Dresser and McKee

40 MGD	$250(40)^{.62}$	=	\$2,500,000
16 MGD	$250(16)^{.62}$	=	\$1,400,000
9 MGD	$250(9)^{.62}$	=	\$1,000,000

2. Labor Costs (Ref. EPA)

40 MGD

Operating labor	1200 mhr
Maintenance labor	930 mhr
	2130 @ \$6/hr = \$12,780/yr.

16 MGD

Operation	730 mhr
Maintenance	600 mhr
	1330 @ \$6/hr = \$7,980/yr.

9 MGD

Operation	600 mhr
Maintenance	510 mhr
	1110 @ \$6/hr = \$6,660/yr.

3. Material and Supply Costs - Based on Average Flow

16 MGD	\$2500 x 171.2/112.2	=	\$3,825/yr.
6.5 MGD	\$1050 x 1.53	=	\$1,606/yr.
3.5 MGD	\$650 x 1.53	=	\$ 995/yr.

4. Annual Electrical Costs

S.W. 45 hp pump

45 x 24 hr. x 365 days x .0149 \$/hp* hr. = \$5,874/yr.

S.E. 115 hp pump

115 x 24 x 365 x .0149 = \$15,000/yr.

Central 550 hp pump

550 x 24 x 365 x .0149 = \$71,800/yr.

5. Summary of O&M Costs

Alternative 2

O&M

Electrical Power	$ 71,800
Labor	12,780
Material and Supplies	3,825
Annual O&M	$ 88,405/yr.

Alternative 5

O&M	S.E.	S.W.	Total
Electrical Power	$ 15,000	$ 5,874	$ 20,874
Labor	7,980	6,660	14,640
Material and Supplies	1,606	995	2,601
Annual O&M			$ 38,115

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